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How to Estimate the Costs of Changes in Army Individual Skill Training

Susan Way-Smith

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Susan Way-Smith

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PREFACE

Changing political and economic conditions in the world have generated unprecedented restructuring and cost-reduction efforts in business, government, and the military. These organizations are scrutinizing all aspects of their operations, and they are paying special attention to the efficiencies and costs of their support functions. Individual training within the military is one of the largest resource consumers among military support functions, and the Army expends the greatest amount of resources for individual training among the services.

As a result of major budget reductions and restructuring efforts, Army policymakers are considering a number of initiatives, in place of traditional methods that are thought to be more costly, which could fundamentally change the ways in which the Army currently conducts individual training. Because these changes could have far-reaching effects on Army costs and capabilities, analytical tools are needed that estimate the costs and savings that might be achieved by changing training approaches.

This Report documents a method for estimating the costs of changing the ways the Army provides individual training. This method is not strictly limited to the Army and may be applied in a variety of organizations and contexts. The basis of the method is a previously developed approach for assessing the cost consequences of changes in military force structure.[1] The method identifies specific training resources available to the Department of the Army and links changes in the application of these resources in selected courses to changes in costs.

This research was conducted as part of a project entitled "Future Individual Training Strategies," sponsored by the Office of the Deputy Chief of Staff for Training, U.S. Army Training and Doctrine Command. The project's overall objectives are to identify training approaches suitable for groups of related occupations, focusing on alternatives to current approaches that better match the content, timing, and location of training to job requirements, while providing the most affordable and effective training methods.

This Report should be of interest to policy analysts concerned with estimating costs and budgets related to major support functions such as training. While its primary objective is to address resource analysis and costing in the Army, the method may also be of interest to those concerned with alternative applications of resources and costing in a variety of contexts. The research was conducted within the Manpower and Training Program of RAND's Arroyo Center.

THE ARROYO CENTER

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[1]Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance* (RAND, R-3748-PA&E/FMP/JCS, September 1990).

Strategy and Doctrine, Force Development and Technology, Military Logistics, and Manpower and Training.

Army Regulation 5-21 contains basic policy for the conduct of the Arroyo Center. The Army provides continuing guidance and oversight through the Arroyo Center Policy Committee (ACPC), which is co-chaired by the Vice Chief of Staff and by the Assistant Secretary for Research, Development, and Acquisition. Arroyo Center work is performed under contract MDA903-91-C-0006.

The Arroyo Center is housed in RAND's Army Research Division. RAND is a private, nonprofit institution that conducts analytic research on a wide range of public policy matters affecting the nation's security and welfare.

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SUMMARY

BACKGROUND

The U.S. Army, along with the Department of Defense as a whole, is reviewing its basic missions and organization in the face of changes in U.S. national security objectives and accompanying reductions in defense budgets. As budget pressures grow, support functions receive special attention; among these, individual training at Army installations has received intense scrutiny. In response, Army policymakers are considering a number of alternatives to current training strategies that might reduce the resources used for individual training. For example, some proposals advocate increased on-the-job training in lieu of formal "schoolhouse" training; others call for increased use of training aids, devices, simulators, or other technology to substitute for the more expensive actual weapon systems; some promote training in civilian facilities to substitute for selected military training courses; and others simply advocate reducing the length of training courses. But, to ensure that such alternative methods will reduce the costs of training, the Army needs a way of estimating how changes to current training approaches will alter the resources and costs required to train in specific instances.

A key problem in determining the potential cost of changing training approaches is that the Army does not now have methods that provide detailed estimates of individual training costs, especially for specific courses, where many proposed changes in individual training will take place. General cost estimates associated with manpower, equipment, and base operations exist, but the manner in which these costs are estimated does not permit detailed analysis of the resources required to produce and execute a change in training strategy in a given course.

A NEW FRAMEWORK FOR ESTIMATING CHANGES IN TRAINING COSTS

This Report describes a method that can permit the Army to formulate estimates of the changes in course costs, given changes in training strategy. This method, which we refer to as the Training Resource Analysis Method (TRAM), examines how a change in training strategy would alter training and support activities and aggregate resource use. TRAM has three objectives:

1. Evaluate training options.
2. Assess the effects of alternative implementations of training options.
3. Estimate changes in costs and savings.

TRAM supports a detailed job analysis procedure that suggests training options and alternative implementation methods encompassing content, location, and timing of the training, as well as training technologies and media.[1] TRAM is used to cost the various training options

[1]Both the training resource analysis method and the job analysis method have been developed as part of a RAND project entitled "Future Individual Training Strategies." The job analysis method is described in more detail in a forthcoming RAND document, John D. Winkler, Susan Way-Smith, Gary Moody, Hilary Farris, James P. Kahan,

that are produced by the job analysis. This combined approach not only analyzes alternatives but also generates promising alternatives to analyze.

TRAM analyzes *changes* in costs and savings that result from a decision governing training. As the method quantitatively measures changes in training costs, it also highlights potential tradeoffs by placing the changes in cost in a meaningful context for the decision maker and detailing implications of alternative training strategies. These details provide the decision maker with information about "what" is being traded for cost savings.

THE STEPS IN THE TRAINING RESOURCE ANALYSIS METHOD

TRAM uses a five-step process to estimate the costs of alternative training strategies for conducting individual training. These are:

1. Specify the baseline (the current course) and the alternative training programs.
2. Analyze current activities and changes in activities (i.e., changes in training development, delivery, and support) implied by the alternative programs.
3. Analyze resource implications of specific changes as these affect manpower, equipment, and facilities.[2]
4. Calculate costs of resource changes among alternative training programs.
5. Place results in context, identifying cost flows, tradeoffs, and risks.

Specify the Training Programs

The most important step in the analysis is to thoroughly define the current course (the baseline) and the proposed alternatives.

Define the Baseline. The first step of the method converts the current course Program of Instruction (POI) to a simple spreadsheet that contains each current training event, instructing department, academic hours, methods of instruction, equipment, ammunition, facilities, and instructor contact hours.

Define the Alternatives. The next step is specification of the alternative training programs. TRAM identifies changes associated with the alternatives that affect who is conducting the training (e.g., are training responsibilities being transferred?); what methods or lessons change; and how and when the changes will be implemented. TRAM also highlights key assumptions that may need to be made concerning the alternatives.

Analyze Activities

Once the baseline and alternatives are defined, the next phase of the method examines how the changes affect the activities at the school and other organizations. Training changes can affect a large number of organizations—both directly and indirectly. In order to capture

and Charles W. Donnell, *Costs and Consequences of Implementing Distributed Training in the Armor Officer Advanced Course*, Santa Monica, Calif.: RAND, MR-118, forthcoming.

[2]The definition of equipment includes supplies, contracts, fuel, and other materiel.

costs, we need to identify all affected organizations. Once we have done this, we then determine how the activities of *training delivery, development*, and *support* change for these affected groups. We translate these delivery, development, and support activity changes into changes in workload factors.[3] We use a balance sheet to record the changes in workload that accompany the changes in training. The balance sheet is the centerpiece of the method, and we use it to track both activity workload changes and resource changes. Table S.1 is the template for the balance sheet.

Table S.1

Balance Sheet: General Format

Activities/ Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change
	Decrease	Increase	Transfer from (-)/to (+) Other Courses or Organizations	Transfer from (-)/to (+) Excess Capacity	
Delivery					
Development					
Support					

There are four fundamental types of changes: activity/resource increases, activity/resource decreases, transfer from/to other courses or organizations, and transfer from/to excess capacity. Targeted organizations are those specifically targeted and directly affected by the change. Other courses or organizations are those that may be indirectly affected by the change. Finally, the balance sheet lists the consequences of these four types of transactions—the net change.

Analyze Resource Implications

In the resource analysis step, TRAM determines how the changes in activities translate into changes in type and quantity of resources required for the alternatives. TRAM identifies all resources required to implement and support the training changes (e.g., training manpower, materials and supplies, equipment, simulators, facilities, etc.). TRAM first summarizes all the activity changes for each alternative. TRAM uses this summary to determine initially whether these changes may be one-time (nonrecurring) activities or whether they are recurring changes in activities.

We estimate the number and type of changes for manpower, equipment, and facilities, and TRAM uses available information and resourcing factors to determine the changes in resources. (Appendix A provides an extensive summary of the information needed to estimate the changes in resources.) We record the changes in the balance sheets for the major categories of resources.

[3]Workload factors are units of measure that relate to the responsibilities of the activity. For example, a key workload factor for training delivery is student input.

Calculate Specific Costs

TRAM summarizes the changes for each alternative in a catalogue of cost-causing changes. To determine the costs of these changes, TRAM uses the general equation:

$$\text{cost} = (\text{cost factor}) \times (\text{resource change})$$

TRAM has a cost template that includes the types of costs that may be incurred when changes are made to a POI. The template serves as a planning tool and checklist to ensure that important cost and resource factors are considered in the analysis.

Place Costs in Context

The final phase of the method involves interpreting the results of the analysis in a meaningful way for the decision maker. This requires comparing the alternatives, "sizing" the costs and savings, identifying the tradeoffs, highlighting the limitations of the analysis, and identifying potentially larger issues that surface during the analysis.

ILLUSTRATION OF THE METHOD

In this Report, we apply the method to two armor courses, the Armor Officer Advanced Course (AOAC) and the M1/M1A1 Armor Crewman One Station Unit Training Course (19K OSUT). The AOAC is the professional development course for armor senior first lieutenants and junior captains. This 20-week course qualifies graduates to assume company command or to function as assistant operations officers at the battalion or brigade staff level. The 19K OSUT course is a combined basic training and advanced individual training course for entry-level armor soldiers. This 14-week course qualifies new armor soldiers to be loaders on the Abrams series tanks. Both courses are conducted at the U.S. Armor Center at Fort Knox, Kentucky.

Armor Officer Advanced Course

The AOAC course was selected because of its potential suitability for "distributed training," an approach that packages instruction so that it may be made available to troops and units in geographically dispersed locations through two major distribution mechanisms—electronic and mail delivery. These mechanisms encompass instructional systems such as computer-based instruction, videotape, and teletraining. The U.S. Army Training and Doctrine Command (TRADOC) believed that significant cost savings might be achieved if course length were reduced and training were supported in field locations using distributed technologies.

We use TRAM to examine four variations for shortening and distributing the AOAC course, and we analyze these using alternative assumptions regarding the costs of implementation ("low" or "high"). The low-cost assumptions (best case) state that sufficient capacity exists in field locations (e.g., post learning centers and armories) to conduct portions of the AOAC. The high-cost assumptions (worst case) suggest that additional equipment, manpower, and facilities are required to conduct this additional training in field locations. The specific variations include: reducing course length by one week (*trimmed course*), distributing 3.8 weeks

of training to unit learning centers (*distributed course*), further reducing course length by modifying course training objectives (*change in mission*), and changing techniques for providing instruction in residence (*small-group transformation*). In addition, we consider two media mixes for the distributed option. One option uses all paper; the other uses a combination of computer-based training, videotapes, and paper. Thus, we examine a total of ten variations of how training might be modified in AOAC.

Armor Officer Advanced Course Results

Briefly, the results show that savings are indeed possible if some "unnecessary" lessons can be eliminated and the course shortened. Distributing training to the home units of course participants could produce substantial savings. However, the magnitude of these savings is contingent on which media are used and how the training is implemented in the field. Varying these assumptions introduces substantial differences in the magnitude of potential cost savings. The results suggest that distributed training could save money only if capacity exists in the field, the costs of developing and supporting the training are low, and "lower-tech" media are used to deliver the training. Finally, the degree to which a course is shortened and distributed is constrained by the course's output objectives. Fundamental changes in expectations for graduates of the AOAC course are required in order to achieve further savings.

M1/M1A1 Armor Crewman Course

The 19K OSUT course was selected as a case study because it is one of TRADOC's most expensive individual training courses. One reason the costs are so high is the number of students who attend the course each year. Over the last several years, the average yearly student input has been over 3,000 students. Another contributing factor is the cost of operating and maintaining the Abrams series tanks. Faced with declining resources and environmental constraints, one of TRADOC's overall strategies for training is the increased use of training aids, devices, simulators, and simulations (TADSS) to substitute for the more expensive actual equipment. If cost-effective and realistic TADSS can be developed to reduce the current operating levels of a large inventory of tanks, then the operating, support, and manpower costs associated with the course can also be reduced.

We examine one alternative to the 19K OSUT course that makes only marginal changes in the course content, but substitutes selected training aids, devices, simulators, and simulations for on-tank training. We analyze this alternative using alternative assumptions regarding the costs of implementation ("low" or "high"). The low-cost assumptions (best case) state that tanks in current inventory can be retrofitted as training devices. The high-cost assumptions (worst case) suggest that additional devices must be procured and that surplus tanks will be transferred to excess inventory.

19K OSUT Results

The 19K OSUT results show that operating and support savings are possible if training aids and devices can be substituted for training on the actual tanks. However, the level of savings

depends on the type of devices and degree of substitution. Also, the level of savings is contingent on how the devices and course changes are actually implemented.

Within the limits of our analysis for the 19K OSUT course, we found that computer-based training (CBT) does not produce significant overall savings.[4] However, there are opportunities for using CBT in the basic portion of this course and all other basic training courses. If CBT is used for basic training events, the costs of developing the material for basic training could be spread over all basic courses, and there would be not only potential economies of scale but also time savings that could be captured using this medium of instruction.[5]

CONCLUSIONS

In applying TRAM to the AOAC and 19K OSUT courses, we gained important insights at each step of the method. For example, in the initial step, we found that any given alternative can be specified in more than one way—depending on the assumptions that are employed concerning implementation of that alternative. This is important because the Army has thus far considered limited means for implementing such new training strategies as distributed training.

In the activity analysis, we found that most of the current systems do not track activities, resources, and costs on a course basis. The current financial systems use other units of analysis such as missions or weapon systems. In this period of budget reductions and cost cutting, there is increasingly a need to analyze individual course costs simply because decisions concerning the instructional methods, course length, and class size have critical cost consequences.

The activity analysis step and the resource analysis step highlighted the importance of the support functions as major activity areas and consumers of resources. However, we found that many of the relationships between changes in support workload and required resources are not adequately defined. Until the support relationships are better defined for Army schools, it will be difficult to quantify how changes in training affect these functions and to identify opportunities for greater efficiencies.

The resource analysis step also uncovered problems with some of the resourcing standards. We found some critical resourcing standards that need to be developed, updated, and reassessed. The resourcing standards are the heart of the resourcing process and need to be scrutinized for accuracy and timeliness. In addition, the underlying or implicit assumptions concerning these standards may need to be re-examined.

When developing the cost models for the alternatives, we found that resources frequently have more than one cost factor. For example, the Armor School sometimes uses fuel and spare parts cost factors provided by the Army Modernization Information Memorandum. At other times, the school uses factors provided by the Operating and Support Management In-

[4]Although CBT is frequently included in a TADSS strategy, we examined CBT as a separate category of analysis because it is sufficiently different from other categories of training devices and we wanted to explore the impact of CBT on basic training.

[5]A standard rule of thumb in CBT literature is a 33 percent time efficiency. That is, the time required for CBT instruction is 66 percent of the time required for traditional classroom instruction.

formation System. Different cost factors yield different results, and it would be beneficial if there were consistency in the use of specific cost factors. In the meantime, it may be that cost analysts and decision makers want to compare results using alternative cost factors. Thus, we thought it important to structure the method to provide the flexibility to use different cost values.

There are three important conclusions that we reached in the final step of the method—placing the costs in context. First, by providing a summary of changes in activities and resources, the decision maker can see what is being traded for savings. Savings are usually generated by trading off other factors such as training effectiveness or capability, and decision makers can use their experience and judgment to determine if the savings are worth the costs. Second, a significant portion of training resources is devoted to training support and base operations functions that are insensitive to course reductions and changes in instructional methods. Without other major changes in training, such as consolidating occupational specialties, facilities, and installations, savings in training costs will be at the margin. And third, while it may be true that some savings accrue by distributing training to the units, there is a point of maximum absorption for the field units. At this point of maximum absorption, investment requirements for distributed training infrastructure support will increase significantly.

Overall, we found TRAM's structured approach to costing courses useful. Without such a structured approach, important resource changes—including indirect effects—can be omitted and critical assumptions can remain unexplored. These omissions result in cost conclusions that are unrealistic and contribute little to informing training decisions. The TRAM method can improve decision making because it can screen many alternatives as well as provide detailed cost estimates of favored alternatives.

TRAM has identified important structural determinants of cost at the course level. Future research would further study the behavior of training costs to include opportunities for scale efficiencies and the broader effects of Army discretionary policies.

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Any remaining errors of fact or interpretation remain my responsibility.

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ACRONYMS

AIT	Advanced Individual Training
AMC	Army Materiel Command
AMDF	Army Master Data File
AMIM	Army Modernization Information Memorandum
AMCCOM	Armament, Munitions, and Chemical Command
AMSCO	Army Management Structure Code
AOAC	Armor Officer Advanced Course
ARPRINT	Army Program for Individual Training
ATRRS	Army Training Requirements and Resources System
BASOPS	Base Operations
BLTM	Battalion Level Training Model
BMG	Budget and Manpower Guidance
BOIP	Basis of Issue Plan
BOPM	Base Operations Predictive Model
CAD	Course Administrative Data
CBT	Computer-Based Training
CER	Cost Estimating Relationship
COB	Command Operating Budget
COFT	Conduct of Fire Trainer
CONUS	Continental United States
CPO	Civilian Personnel Office
CRISS	Course Resource Information Support System
C&S	Command and Staff
DAC	Deputy Assistant Commandant
DCSA	Deputy Chief of Staff for Analysis
DCSLOG	Deputy Chief of Staff for Logistics
DCSPER	Deputy Chief of Staff for Personnel
DCSRM	Deputy Chief of Staff for Resource Management
DCST	Deputy Chief of Staff for Training

DEH	Directorate of Engineering and Housing
DOES	Directorate of Evaluation and Standardization
DOTD	Directorate of Training and Doctrine
DPA	Directorate of Personnel
DPTM	Directorate of Plans, Training, and Mobilization
DRM	Directorate of Resource Management
DS	Direct Support
DT	Driver Trainer
DTV	Driver Training Vehicle
FORSCOM	U.S. Army Forces Command
FPS	Facilities Planning System
GS	General Support
ICH	Instructor Contact Hour
ITP	Individual Training Plan
JFTR	Joint Federal Travel Regulations
LIN	Line Item Number
MER	Manpower Estimating Relationship
MOS	Military Occupational Specialty
MPA	Military Personnel, Army
MS3	Manpower Staffing Standards System
OCONUS	Outside Continental United States
OMA	Operations and Maintenance, Army
OPTEMPO	Operating Tempo
OSD	Office of the Secretary of Defense
OSMIS	Operating and Support Management Information System
OSUT	One Station Unit Training
PBG	Program Budget Guidance
PPBES	Planning, Programming, Budgeting, and Execution System
PPBS	Planning, Programming, Budgeting System
PCS	Permanent Change of Station
POI	Program of Instruction
POL	Petroleum, Oil, and Lubricants

POM	Program Objective Memorandum
RBCL	Requirements Based Course List
RFH	Resource Factor Handbook
R-PLANS	Real Property and Analysis System
SAT	Systems Approach to Training
SMDR	Structure/Manning Decision Review
TAADS	The Army Authorization Documents System
TADSS	Training Aids, Devices, Simulators, and Simulations
TAEDP	Total Army Equipment Distribution Program
TAFCS	The Army Force Cost System
TAMIS	Training Ammunition Management System
TAMMS-EDB	The Army Maintenance Management Systems Equipment Data Base
TDA	Table of Distribution and Allowances
TDY	Temporary Duty
TOE	Table of Organization and Equipment
TRAC	TRADOC's Analysis Command
TRADOC	Training and Doctrine Command
TRAM	Training Resources Analysis Method
TRAMEA	TRADOC Management and Engineering Activity
TRAS	Training Requirements Analysis System
TRM	Training Requirements Management
TT	Turret Trainer
TTHS	Transients, Trainees, Holdees, and Students
UIC	Unit Identifying Codes
USAFAC	U.S. Army Finance and Accounting Center

1. INTRODUCTION

The U.S. Army, along with the Department of Defense as a whole, is reviewing its basic missions and organization in the face of changes in U.S. national security objectives and accompanying reductions in defense budgets. As budget pressures grow, support functions receive special attention. In particular, individual training at Army installations, one of the key missions of the Training and Doctrine Command (TRADOC), has received intense scrutiny.[1]

Army individual training consumes considerable resources. Individual training represented approximately 8 percent of the Army's overall budget in FY (fiscal year) 91: 6 billion dollars. The percentage is still significant for FY 1992, even though the total Army budget has decreased.[2]

Army manpower in support of training represented about 8 percent of the Army's overall manpower allocations in FY 91, with approximately 45,000 military (both officer and enlisted) and 29,000 civilians.[3] Currently, individual training encompasses over 100,000 active and reserve students per day at over 20 Army schools.

Given these costs, Army policymakers are considering a number of alternatives to current training strategies that might reduce the costs, manpower, and resources used for individual training. For example, some proposals advocate increased on-the-job training in lieu of formal "schoolhouse" training; others call for increased use of training aids, devices, simulators, or other technology to substitute for the more expensive actual weapon systems; some promote training in civilian facilities to substitute for selected military training courses; and others simply advocate reducing the length of training courses. But, to determine whether such alternative methods will reduce the costs of training, the Army needs a way of estimating how changes to current training approaches will alter the resources and costs required to train in specific instances. The Army also needs a way of ensuring that the training changes effectively link to the Army's overall strategic training objectives.

PROBLEM

A key problem in determining the potential cost of changing training is that the Army does not now have accurate methods for estimating costs of individual training. General estimates of the costs of training courses exist, but the aggregate manner in which costs associated with manpower, equipment, and base operations are estimated does not permit detailed analysis of the activities associated with producing and executing a training course. This is a serious problem because many of the proposed alternative training strategies will be imple-

[1]TRADOC's overall mission is to prepare the Army for war and to be the architect of the future. TRADOC does this by supervising the doctrine development process, the combat development process, and by conducting training.

[2]The training percentage of the Army's budget was calculated by including all items under the training subprogram (P8-Training).

[3]Department of Defense, Office of the Secretary of Defense, *Military Manpower Training Report for FY 92*, Washington, D.C., May 1991.

mented at the training-course level and the Army needs to know whether these strategies do, in fact, reduce the costs for a particular course.

RESEARCH OBJECTIVES

The objective of this Report is to describe a course-level costing method that can be used to develop estimates of the costs of changing Army individual training. The method evaluates alternative strategies for conducting training courses and various potential implementations of these alternatives. This method—the training resource analysis method (TRAM)—examines how an alternative training strategy would change training and training support activities and resource use.

TRAM supports a detailed job analysis process that is designed to inform the decision maker of the critical content of an individual training course, alternative locations and the timing of the training, and alternative mixes of training technologies.[4] This combined approach of the job analysis and TRAM is a way not only of analyzing alternatives, but also of generating promising alternatives to analyze.

ANALYTIC APPROACH

Figure 1.1 illustrates how the job analysis steps and the training resource analysis method fit together.

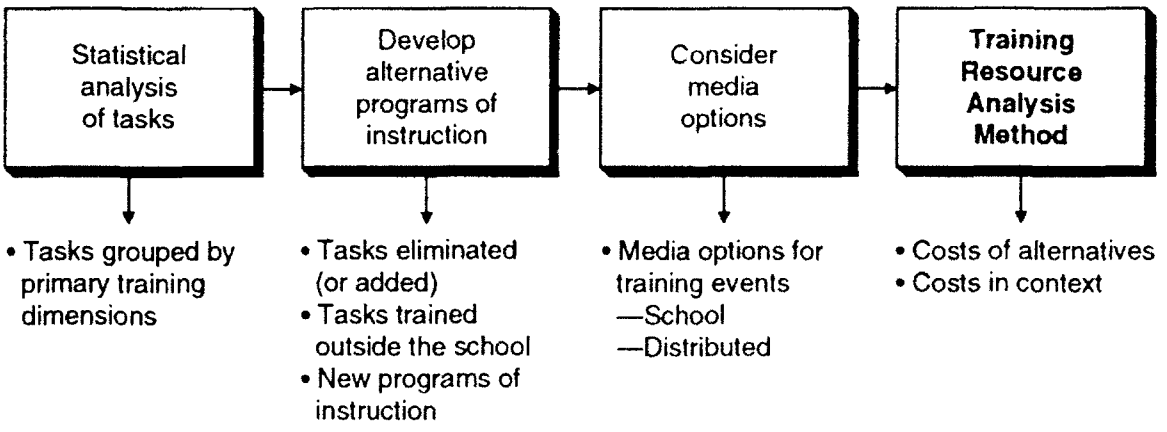


Figure 1.1—Job Analysis and Training Resource Analysis Method Processes

The first three boxes in Figure 1.1 highlight the steps in the job analysis method that develop the alternatives to a training course. Once these alternatives are developed, the training resource analysis method (TRAM), as shown the fourth box, is used to evaluate the

[4]A forthcoming RAND document (John D. Winkler, Susan Way-Smith, Gary Moody, Hilary Farris, James P. Kahan, and Charles W. Donnell, *Costs and Consequences of Implementing Distributed Training in the Armor Officer Advanced Course*, Santa Monica, Calif.: RAND MR-118, forthcoming) details the methodology of the job analysis.

alternatives—including alternative implementations and the estimation of changes in savings and costs.

Overview of the Job Analysis Approach

Because the job analysis generates the course alternatives evaluated by TRAM, it is important to provide a brief overview of the steps involved in the job analysis. The first step is a statistical analysis of tasks required in the occupation.[5] The results identify, for example, tasks that are central to the occupation, such as combat survival skills. The next step of the job analysis method analyzes the existing program of instruction (POI) and compares the tasks taught in resident training with their rankings in the previous step.[6] An important result of this step is the development of alternative new POIs. The third step of the job analysis considers media options for the new POIs. These media options include a range of technologies that could be used both in schoolhouse training and in training that might be conducted in other locations. The training resource analysis method is then used to cost the various new POIs (including alternative media, technologies, and alternative implementations) that are produced by the job analysis.

The Training Resource Analysis Method (TRAM)

TRAM is different from current Army training cost methods in three ways. First, it examines activities, resources, and costs at a much more specific level of detail than current Army costing methods. TRAM examines activities, resources, and costs at the course and lesson plan/event level of detail.[7]

The second way TRAM differs is that it focuses on *changes* in costs that result from a training decision. The Army's current methods allocate total fixed and variable costs.[8] While these Army methods may have been sufficient for budgeting purposes in a relatively stable environment in the past, the present context of major end-strength reductions, budget cuts, and mission changes requires a method that can determine whether new training strategies can actually generate savings.[9]

The third way TRAM is different is that in addition to quantitatively measuring costs, it also highlights tradeoffs by detailing the specific changes that result from implementing alterna-

[5]The analysis includes measures relevant to training, including: frequency and locus of performance, consequences of inadequate performance, and additional attributes (e.g., whether it is an enabling skill, reasoning skill, etc.). The analysis yields major groups and ranks the tasks according to their training-related similarities.

[6]Using logical decision rules, tasks that are ranked as less critical and less frequently performed could be considered for distributed training. The job analysis identifies tasks that could be eliminated (or added) to the training course. Tasks that may be trained outside the schoolhouse can also be identified.

[7]According to the Army's designation, the various lesson plans that comprise a course are training events.

[8]A cost that is uniform on a per unit basis, but that fluctuates, in total, in direct proportion to changes in activity levels is variable. A cost that remains constant in total despite fluctuations in activity for a given period of time is considered fixed. A fixed cost does not change in total, but may become smaller on a per unit basis as activity volume increases.

[9]The Army's current methods are only able to account for changes in student input and course length.

tive training strategies and places those changes in a meaningful context for the decision maker. Training ultimately affects soldier performance, and if changes are to be made to individual training programs, decision makers need to know not only the costs of those changes, but also what they are potentially trading for the savings. The current Army training cost methods do not provide detailed information on changes in training. Without this information, training cost studies may fail to adequately inform the decision process, which could lead to inappropriate training changes that could affect the capability of the units.

TRAM is for decision making, but the method can contribute to the budgeting process by aiding cost analysts who are required to evaluate the cost consequences of altering training (e.g., shortening courses, changing media and the media mix used in courses) during the programming and budgeting phases of the Planning, Programming, Budgeting, and Execution System (PPBES).[10]

FOUNDATION FOR THE TRAINING RESOURCE ANALYSIS METHOD

The method described in this Report builds on and extends recent RAND research that examines the cost consequences of altering the active/reserve balance.[11] The general balance sheet approach used in the activity analysis and resource analysis is adapted from this research. The concept of cost models tailored to specific training problems and the general cost template were also derived from this earlier research. All other aspects of the method were developed especially for the evaluation and costing of alternative training strategies.

ORGANIZATION OF THIS DOCUMENT

Section 2 describes in greater detail the current Army approaches to costing training, why a new costing approach is needed, and the requirements for this new approach. Section 3 defines the method's general framework, covering specification of the baseline course and the alternatives, the activity analysis, resource analysis, cost analysis, and placing the costs in context for the decision maker. Section 4 applies the method to the Armor Officer Advanced Course (AOAC), which is conducted at the U.S. Army Armor School and Center, Fort Knox, Kentucky. The AOAC analysis addresses the effects and cost results of shortening a course and distributing training to field units. Section 5 applies the method to the M1/M1A1 Armor Crewman One Station Unit Training (19K OSUT) course, which combines basic training and advanced individual training. Our analysis of the 19K OSUT course focuses on the effects of substituting training aids, devices, and simulators for the actual weapon systems. Section 6 summarizes our conclusions concerning the application of the method. Appendix A covers an array of resource and cost factors and basic equations that can be used in costing training alternatives. Also included are data sources for analysts to use in preparing cost estimates of training changes. Appendix B includes the cost models of the alternatives examined in the

[10]TRAM has already contributed to Army decision making in assessing the cost consequences of alternative training strategies in two important ways. First, assessments of initial costs of a training strategy were altered based on TRAM's recommendation to use authorized resources. Second, a media strategy using teletraining was postponed based on TRAM's initial findings concerning the high cost of this medium.

[11]Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance*, Santa Monica, Calif.: RAND, R-3748-PA&E/FMP/JCS, September 1990.

AOAC case study. Appendix C includes cost models for the "high-cost" alternative examined in the M1/M1A1 Armor Crewman OSUT course.

2. DETERMINING TRAINING RESOURCES AND COSTS: CURRENT PRACTICES AND FUTURE NEEDS

We have three purposes in discussing current Army resourcing and cost methods. The first is to describe the current procedures for resourcing Army training and the methods used to calculate the costs of Army individual training. Resources are the inputs to training and the pieces necessary to conduct training. Resources include manpower, equipment, facilities, and the functional categories such as maintenance and scheduling that are combinations of these resources. These resources all have costs, and the challenge is to ensure that all costs are captured so that the decision maker knows how changes in resources and training strategies will change the costs associated with producing a trained soldier. The current Army training cost models consider many of the resource inputs, but omit important factors such as transition costs associated with changing training.

The second purpose is to access the usefulness of current resourcing and cost methods for evaluating alternative training course strategies in the Army's current environment of rapid change. The Army has detailed processes and standards for determining what resources are required to train soldiers. However, its current costing methods do not use these standards to determine costs. These current Army cost models use highly aggregated TRADOC historical information to project future costs. As a result, these models do not capture the cost ramifications of change to the Army as a whole, nor do they capture important elements such as new training devices, new weapon systems, or different methods of training.

Our third purpose is to describe the requirements for a new approach that addresses the problems that exist with the current approaches. In a context of rapid change, the effects of changes need to be considered for the Army and not simply for TRADOC. In addition, other factors, such as resource requirements necessary to change the traditional way training is conducted, must be included in the cost models.

RESOURCING INDIVIDUAL TRAINING AND CURRENT COSTING METHODS

Training over 100,000 soldiers per day is a complex and dynamic process, and in order to describe the process that enables TRADOC to conduct this training, we need to first explain how individual training is currently organized. We then need to examine the methods used for determining and allocating the necessary inputs (e.g., resources and functions) required to produce trained soldiers. Finally, it is important to investigate how the Army links these training inputs to costs. We need to identify the resource elements that the current Army cost models include and exclude.

The Organization of Individual Training

TRADOC's Deputy Chief of Staff for Training (DCST) oversees the individual training activities at the TRADOC schools and Army training centers. Other TRADOC command groups, such as Combat Development, Resource Management, and Engineering, provide support for this effort. Figure 2.1 illustrates the individual training organization.

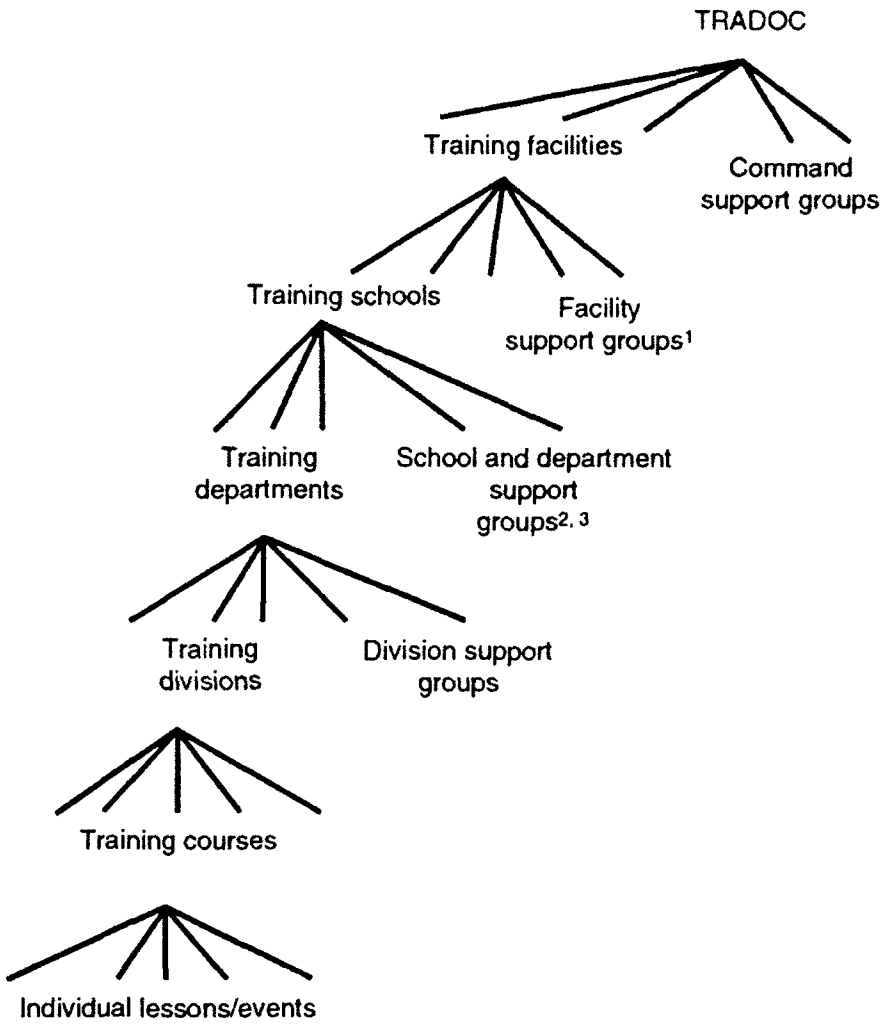


Figure 2.1—Training Hierarchy

Within TRADOC are over 20 training facilities that house schools and facility support groups. Each school usually focuses on particular types of individual training missions. For example, Fort Knox concentrates on armor, so its missions for individual training concentrate on general skills training for soldiers in the armor branch. The facility support groups provide critical functions such as security, supply, and housing.

Within the schools are training departments that concentrate on general subject areas (e.g., maintenance). Other departments, such as the Directorate of Training and Doctrine (DOTD) or the Directorate of Evaluation and Standardization (DOES), support the training depart-

ments through activities such as training instructors, developing new training devices, and evaluating training.

Each training department is composed of training divisions that focus on specific aspects of individual training. For example, within the Maintenance Department at the Armor School are the Turret Division, the Automotive Training Division, and the Maintenance Management Division. There are also division support groups within the training departments, such as the Program Management Division of the Maintenance Department, which provides operations and administrative services.

Each training division has a number of courses that vary in duration and class size. And each course is comprised of individual training lessons/events that are intended to train an occupational task or series of tasks. Each training event may use one or more instructional methods (e.g., practical exercises, small group instruction, or computer-based training) that may require different quantities and types resources.

All of these organizations—TRADOC Headquarters, the schools, the training departments, and the training divisions—have authorization documents to reflect their organizational structure. These authorization documents state the approved structure and resources and serve as a basis and authority for requisitioning people and equipment. TRADOC's mission is a support mission, and its organizations' authorization documents are Tables of Distribution and Allowances (TDA). TDA organizational requirements are based on the type and level of workloads associated with the organization's mission. For example, although schools may be organized similarly, each one will have a substantially different mix and number of personnel and equipment authorizations due to differences in student population, student enrollments, and the branch of the Army they support. As a result, the resource requirements for these schools vary significantly.[1] The TDA documents for TRADOC's organizations are unit specific and report both *requirements* and *authorizations*. Requirements reflect wartime resource needs. Authorizations reflect budgeted levels of resources. Authorizations for TDA units are maintained by The Army Authorization Documents System (TAADS).[2]

Identification of Resource Inputs

As we have noted, the Army's individual training organization consists of many unique TDA units, and these organizations' structure and resource inputs are determined by their individual type and the quantity of their workload.

Resourcing Standards. The Army has developed resourcing standards that govern how resources are equated to workload.

[1]The authorization document for war-fighting units is a Table of Organization and Equipment (TOE). Unlike a TDA, a TOE cannot contain spaces for civilians. Many Army combat units have the same TOE.

[2]There are several steps required before a school's TDAs are finalized and recorded in TAADS. The first step is the Structure/Manning Decision Review (SMDR). This is a process that balances resources against requirements. In the training arena, it compares the total Army requirements on a *course-by-course* basis against the training capability (current authorized levels of resources) of the training installation. The focus of the process is to examine the training resources and requirements established for the program year (two years in the future). The SMDR notes shortages of resources for programmed training and establishes the way to resolve the shortages.

Manning: Manning and organizational structure for TDA units are determined by several different methods. One of the methods is the Manpower Staffing Standards System (MS3). MS3 is a series of linear equations that relate workload to manning.[3] This is done by converting workload to workload factors. For example, in order to teach a course, the schools need instructors. To calculate the number of instructors needed for a course, the schools determine how many monthly instructor hours are needed by the course and then they divide by the number of available man-hours in a month. Instructor hours is the workload factor for instructors. MS3 equations do not exist for every function in the school. As a result, other methods such as manpower surveys or staffing guidelines, which also relate training workload to manpower needs, are used.

Equipment/Materiel: Equipment, materiel, and supplies are determined for these training organizations through the Basis of Issue Plan (BOIP). The BOIP is a planning document that includes the planned placement of new, improved, or existing items of equipment. It is used for logistics support and distribution planning for the Army supply system. The BOIP is updated with equipment utilization data to determine the equipment and materiel requirements. Each school has a system to track equipment use and maintenance for all major items of equipment. From this system, the school can determine the amount of maintenance downtime for major equipment systems and the necessary additional equipment to serve as backup.

Facilities: Facilities are determined by manpower and equipment. Army criteria define authorized facilities in terms of square footage allowances depending on the functions and missions of a set of organizations. For example, maintenance facilities are based on the number and size of vehicles and the number and type of maintenance personnel. The Army Stationing and Installation Plan updates the manpower and equipment facilities' requirements based on projected student enrollments.

The resourcing standards for manpower, equipment, and facilities are then applied to the organization's projected workload.

Workload Factors. Training workload factors for the training installations come from three sources. The first is the Training Requirements Analysis System (TRAS). The second source is the Army Training Requirements and Resources System (ATRRS). And the third source is the Army Program for Individual Training (ARPRINT), which is an essential element of ATRRS.

TRAS establishes the initial manpower, equipment, and facilities resource requirements for a course and guides the subsequent resource allocations. The three essential sources of information concerning courses generated by TRAS are the Individual Training Plan (ITP), the Course Administrative Data (CAD), and the Program of Instruction (POI). The ITP is the planning document for an individual course. It is prepared approximately three years before the commencement of a course in order to initiate the planning for resources needed to conduct the course. The CAD is used for the development of student input requirements for new and revised courses and establishes a course file in the ATRRS. The CAD is prepared 18 to 24 months prior to the implementation or revision of a course. The CAD establishes course prerequisites, scope, length, optimal class size, frequency, and training location. The POI is

[3]The MS3 assumes peacetime operations and a workday of eight hours.

the formal course document and is normally prepared six months prior to either the start of a course or the implementation of major changes in a course. The POI identifies the specific manpower, equipment, and facilities resources required to teach the course.

ATRRS produces the third source of information on training courses, the projected training requirements for a fiscal year, or the Army Program for Individual Training (ARPRINT). ATRRS also contains other key course and school data such as the length of a course, the installation's capacity limits, the frequency of the course, and the location of the course. ATRRS maintains information on training loads, attrition, and instructor hours, and it also notes the source of students for the various courses (e.g., branch and component).[4]

Once the resource inputs are identified, decisions must be made concerning the allocation of resources. This is the resource allocation process. The allocation of resources is the overall budget process of the Army—the Planning, Programming, Budgeting, and Execution System (PPBES) for TRADOC and the training installations.

Allocation of Resources

In the planning stage of the PPBES, TRADOC submits its proposal for resource allocations in its Program Objective Memorandum (POM) to the Army's Director, Program Analysis and Evaluation. The programming phase of the system includes TRADOC review of the training installations' identification of resource requirements (inputs). TRADOC then recommends which training programs and courses will be resourced. The budget phase includes the TRADOC Command Operating Budget (COB) and the finalization of the installations' budgets.

TRADOC activities are funded by a number of different appropriations. The Operations and Maintenance, Army (OMA) appropriation funds civilian pay and benefits and operating costs for the schools. The Military Personnel, Army (MPA) appropriation provides the pay and allowances for military students and instructors. Procurement funds pay for training ammunition and devices, military construction funds pay for facilities, and the family housing appropriation maintains family housing at training installations.

The majority of TRADOC's funds are within the OMA appropriation. Within the OMA appropriation, there is one program that principally affects TRADOC's training, Program 8-Training. Within this program are mission accounts. These accounts are the training missions for the schools. The major school training missions include: recruit training, officer acquisition training, specialized skill training, flight training, professional development education, One Station Unit Training (OSUT), direct training support, and training base support.

[4]Documenting the bottom-up view required a review of several Army publications: U.S. Army Training and Doctrine Command (TRADOC), *Systems Approach to Training*, TRADOC Pamphlet 351-4, Hampton, Va., 1990; U.S. Army War College, *Army Command and Management: Theory and Practice*, Carlisle Barracks, 1989; U.S. Army Training and Doctrine Command (TRADOC), *The Training Requirements Analysis System*, TRADOC Regulation 351-1, Hampton, Va., 1988; U.S. Army Training and Doctrine Command (TRADOC), *Army Program Resource Factors*, TRADOC Pamphlet 11-12, Hampton, Va., 1991.

Within Program 8-Training are subdivisions of these mission accounts called program elements or Army Management Structure Code (AMSCO). AMSCOs are a more detailed breakdown of the general missions and include activities such as advanced individual training, drill sergeants school, noncommissioned officer academy, training support to units, training development, transportation operations, and resource management. For a school such as the Armor Center, there are over 75 different AMSCOs. It is at the AMSCO level where decisions are made about resource allocations to the schools. An AMSCO can cover a wide range of courses. For example, at Fort Knox the same AMSCO covers 48 different courses ranging from the Armor Officer Advanced Course (AOAC) to the M60A1/A3 Tank Turret Mechanic.

The identification of resource inputs is a fairly detailed process with specified standards that relate resource requirements to workload on a course basis. In allocating these resources, the Army assembles the course requirements into the larger AMSCO pieces that cover a number of different courses. This procedure is reasonable for allocating resources. However, when the AMSCOs are used to cost an individual training course, important course characteristics and costs are obscured. This is a problem we detail later in this section. However, it is important to first describe how the current Army costing methods use the aggregated AMSCOs and the general mission accounts to cost courses.

Current Army Costing Methods

The source of most cost data for the training installations is the TRADOC Deputy Chief of Staff for Resource Management (DCSRM). The DCSRM produces two major reports that supply training cost information. Both reports use the data supplied by the U.S. Army Finance and Accounting Center (USAFAC) 218 report, which summarizes expenses and obligations for training installations at the AMSCO level.

Resource Factor Handbook. One of the reports published by the DCSRM is the *Resource Factor Handbook*. This report provides cost factors for TRADOC training schools. One set of estimates refers to the (non-trainee) manpower used in training and provides parameter values from manpower estimating relationships (MERs). Another set refers to non-manpower costs, and provides parameter estimates for cost estimating relationships (CERs). The purpose of this report is to help budget developers project budget increments or decrements based on projected workload changes.[5]

The *Resource Factor Handbook* determines cost estimating relationships by training installation and AMSCO. TRADOC uses the AMSCOs to identify costs by type of training (e.g., general skills training, recruit training, flight training). The costs exclude ammunition costs, since this is not charged to the training installation OMA budget. Information in the Program Budget Guidance (PBG) for TRADOC contains manpower and cost estimates for training related to new systems, and TRADOC incorporates that information in the fixed and variable portions of the related CERs and MERs.[6] The MER parameters pertain to total au-

[5]The variable cost parameters in the *Resource Factor Handbook* are the key factors used in this process. See U.S. Army Training and Doctrine Command (TRADOC), Deputy Chief of Staff for Resource Management, *Resource Factor Handbook*, July 1991.

[6]In addition to the A and B parameter estimates, the maximum and minimum workload underlying each CER and MER is reported in the *Resource Factor Handbook*.

thorized manpower. Share factors allow the total to be distributed among the officer, enlisted, warrant officer, and civilian categories. The share factors are the ratios of authorizations to requirements for each installation.

The handbook uses two methods—one based on statistical analysis of actual experience and one based on resourcing standards:

Statistical Method. This method uses correlation, and regression analysis is applied to a multi-year database (in some cases as much as 18 years). The historical data are normalized to account for changes in recent operations.[7] The equations are estimated from time series data for each training installation. The equations are linear and in the form of $y = A + Bx$. The y is the cost or manning and the x is the workload. A is interpreted as the training fixed cost or fixed manpower and B is an estimate of the incremental cost of increasing the workload.[8] TRADOC uses the correlation/regression method for CERs and MERs for each school for the following mission accounts:

- Recruit Training
- One Station Unit Training
- General Skills Training
- Officer Candidate School
- Professional Military Education
- Undergraduate Pilot Training
- Other Flight Training
- General Intelligence Training
- Cryptological and Related Skill Training
- Reception Stations
- Base Operations for Training Facilities support

Resource Standards Method. The MERs for Recruit Training and OSUT are predicted by "structure models" that reflect standards rather than actual experience for the level of instructional manpower in these activities. There are predetermined numbers of companies, platoons, and drill sergeants that are required for this training. For example, there is one armor OSUT training platoon for each group of 27 students. Each one of these platoons has two drill sergeants.

Cost per Graduate/ATRM-159. The second report published by the DCSRM is the ATRM-159, which provides estimated costs per course per graduate by school. The costs per graduate include instructors, students, supplies, ammunition, and indirect costs such as medical

[7]For example, the historical cost values are adjusted to make them comparable to current values when an operation is converted to a contract.

[8]Under this specification, the incremental cost is constant and equals both the marginal and average variable cost per unit of workload.

support, base operations, and family housing.[9] The ATRM-159 has two very specific and limited purposes. The first is to cost increases or decreases in student enrollment or course length. The second is to estimate future total course costs based on the costs of the past.

The ATRM-159 uses the CERs and MERs from the *Resource Factor Handbook* to determine individual course fixed and variable costs. The ATRM-159 calculates course costs by prorating the school's total costs across the courses based on each course's student load. Once each course has a total cost figure, then the appropriate CER and MER equations are applied to determine how much of costs and manpower are fixed or variable.

These two costing methods are not unique to the Army. The Navy and Air Force use similar methods for determining training costs. These methods worked satisfactorily in the last decade because the services' environment was fairly stable. However, with major changes in missions and funding, the methods have received major criticism. Recently, the Comptroller of the Department of Defense has sought to change these methods by developing an approach based on "costs per student."[10] This approach has not been finalized, and there are a number of issues concerning the correct measure of students for individual training.[11]

ASSESSMENT OF CURRENT METHODS

The resourcing process is conducted at a sufficient level of detail to identify the inputs of a course, but the current costing of training is too aggregate. Through the resourcing process, we can identify many of the specific resources required for the activities associated with individual courses and examine the effects of changing those resources. However, with the current costing methods and their level of aggregation, there is not sufficient information to identify training costs or to examine the effects of new training strategies (e.g., new technologies, new training content, or alternative locations) on individual course costs.[12]

The level of aggregation of the current methods creates three basic problems. First, the methods can assess only a limited category of training changes. Second, they cannot assess indirect effects of training changes. And third, they cannot examine the cost effects of changes at the course level—which is where the new training strategies will be implemented.

Assessing a Variety of Training Changes

Current methods can examine only the costs of changes in student input and course length, and they rely on historical information to estimate these costs. That is, they assume that

[9]U.S. Army Training and Doctrine Command (TRADOC), Deputy Chief of Staff for Resource Management, *MOS Training Costs*, Fort Monroe, Va.: Headquarters TRADOC, 1991. In addition, there is a third method of costing training, which is used to determine the appropriate fees to charge foreign military students. This approach duplicates the ATRM-159 report in many ways. However, there are a few additional costs considered in the foreign military costing that are not considered in the ATRM-159.

[10]Department of Defense, Office of the Comptroller, *Development of a Financial Management System Based on Cost per Output*, Washington, D.C., August 1990.

[11]One issue is whether graduates or student input should be used as the measure of output.

[12]With the current costing methods, schools with high variable costs continue to receive high budget increments for additional workloads, but the factors that influence those high variable costs are not visible.

course content, equipment, manpower, and facilities will not change. In the Army's current climate, this is not sufficient. TRADOC, confronted with major manpower and budget reductions, has developed a number of new concepts for guiding future training programs that could significantly change the traditional way courses are conducted.[13]

One new major effort by TRADOC is called *combined arms training strategy*. This effort is designed to minimize the time needed to train Army units to the standards needed for deployment. Under the umbrella of the combined arms training strategy is a concept called *distributed training*. This strategy envisions a reduction in the length of training courses accompanied by an increase in individual training in Army field units using paper-based instruction, videotape, computer-based training, interactive videodisc, and teletraining. Another concept under the combined arms strategy is the increased use of training aids, devices, simulators, and simulations (TADSS). This concept calls for a greater mix of field training and simulators for individual training and collective training. Costing methods need to be able to assess the effects of these types of training changes for the Army.

Identifying Other Affected Organizations and Indirect Effects

The current costing methods cannot account for effects on organizations other than TRADOC, and they cannot account for indirect effects of training changes. This is a problem because the concepts being considered by TRADOC affect the many organizations within TRADOC and throughout the Army. Combat units and combat support organizations are dependent on the training provided by the school. Changes at the school affect these organizations. The close connection between the training conducted at the school and its effect on other Army organizations can frequently produce compensating changes if school training is altered. For example, if the school determines that a particular skill will no longer be trained in a course, the operating unit may be required to train the soldier in that skill. This requirement may necessitate the expenditure of resources for the units, which may indirectly affect other organizations. In this case, savings for the school have translated into costs for the units. Ignoring these effects overstates the total cost savings of the training decision.

Course-Level Costing

In providing estimates of course costs, the current methods pool the costs within an AMSCO and then use student input to derive a per course figure. This level of aggregation causes problems because individual courses vary greatly, and using the AMSCOs to determine course costs obscures factors that may be driving costs. For example, at Fort Knox there are three different OSUT courses included in that OSUT AMSCO, and each course trains differently and uses different equipment. The current OSUT AMSCO includes the M113 Cavalry Scout Course, the M60A3 Armor Crewman Course, and the M1/M1A1 Armor Crewman Course. The annual enrollment for the M1/M1A1 course has been increasing significantly over the last few years, while the other courses' inputs have been decreasing. To operate the M1/M1A1 is much more expensive than the M60A3s or the M113s. Yet the OSUT cost esti-

[13]U.S. Army Training and Doctrine Command (TRADOC), *Army Training 2007 (Final Draft): Planning for Army Training*, TRADOC Pamphlet 350-4, Hampton, Va., 1990.

mating relationships (CERs) are pooled within the AMSCO and are based on historical student loads for M60A3s and M113s, which formerly represented the bulk of the student input. As a result, maintenance and fuel budgets have been, and continue to be, severely underestimated. By using the AMSCO level, the current costing methods cannot capture the changes that are occurring at the course level, nor can they examine future changes that are planned for implementation at this level of analysis.

MEETING THE NEW REQUIREMENTS FOR COSTING INDIVIDUAL TRAINING

Our assessment of the current costing methods noted that there were three basic problems caused by the level of aggregation of the current costing methods: inability to assess important changes at the course level; inability to consider organizations outside TRADOC or to consider indirect effects; and limited ability to assess a wide variety of changes in training. A new method needs to address those problems and to deal with the Army's dynamic environment by being able to screen a large number of alternatives (including alternative implementations) and to develop detailed cost projections for a favored few alternatives.

In developing a new method for costing changes in individual training, we need not only to address these problems, but also to carefully determine the answers to three very basic questions:

1. What costs are important?
2. To what are we comparing costs?
3. Whose costs should we consider?

What Costs Are Important?

The costs that are important in this context are the costs associated with an individual training course. There are several reasons why the course is the focus of our new costing method. First, changes are being implemented at the course level. We need to have a sufficiently detailed method to identify costs at this level. Second, in the training context, the output of the process is the trained graduate, and each individual training course produces its own products (i.e., graduates). Each individual training course at TRADOC installations is like a production process. The course requires certain activities and resources to be conducted—just as a production process requires certain activities and resources. A course's "production" activities can be categorized under three general headings: delivery, development, and support. These headings encompass all the key activities associated with training, and they are general categories of training activities used in both business and education.[14] Table 2.1 further defines these activity areas. Each of these key activity areas has different cost structures, and each is affected differently by changes in training.

[14]The economic analysis of education uses production functions that include these three categories.

Table 2.1

Training Activity Definitions

Activity	Definition
Delivery	Activities, functions, and tasks involved in conducting the training. Includes actual instruction, setup, and safety precautions.
Development*	Activities, functions, and tasks determining what is to be trained, which instructional methods will be used, and where training will be conducted. Includes curricula development and selection, development, and procurement of methods of instruction and aids to instruction (e.g., training aids, devices, simulators, and simulations).
Support	Activities, functions, and tasks to manage the development and delivery of training. Includes administration, maintenance, housing, and scheduling.

NOTE: *Formal training development activities for both schools and units are part of the school activities.

One area of research that helped us to focus on these specific activities, their costs, and the effect of changes on them is recent work in activity-based accounting and activity-based investment management.[15] This research focuses on an analysis of specific activities that influence costs. The approach identifies the impact of changes on the cost, performance, and interdependencies of activities. Workload analysis is a key part of this approach. The Army's current resourcing process provides us with many detailed course workload factors which enables us to apply this activity analysis approach in our new method.

To What Are We Comparing Costs?

We consider cost in the context of the decision and the alternatives offered. Costs are the consequences of decisions, and costs are identified by specifying the decision and comparing alternatives. In our method, we specify how the alternative training strategies will change the current course and determine the costs and savings of those changes. We focus on changes in costs and savings, and adopt a general costing method that is frequently called incremental or delta costing.[16] TRAM, like incremental costing, is very detailed. We examine changes in recurring costs and one-time cost effects. That is, we examine the changes to costs that occur over again (from one period to another) or at specified intervals. For example, in the training context these recurring costs would be ongoing training management and delivery activities. We also examine nonrecurring costs or the one-time costs that are a part of implementing the alternative. Examples of nonrecurring costs in the training context are the development of training devices or the procurement of specific training equipment.

[15]James Brimson, *Activity-Based Investment Management*, New York: American Management Association, 1989; James Brimson, *Activity-Based Accounting: An Activity-Based Costing Approach*, New York: John Wiley & Sons, 1991.

[16]Benjamin S. Blanchard, *Design and Manage to Life Cycle Costing*, Portland, Oreg.: M/A Press, 1978. TRADOC's Deputy Chief of Staff for Analysis uses an approach called "decision costing" to assess the cost analyses associated with various proposals. This decision costing approach also examines *changes* in costs. Information concerning TRADOC's decision costing will be provided in U.S. Army Training and Doctrine Command (TRADOC), *Studies and Analysis Handbook*, TRADOC Pamphlet 11-8, revision forthcoming.

One common criticism of incremental costing is that it may not recognize some cost effects and that this results in underestimating the costs or savings.[17] In order to address this potential problem, we needed to develop a comprehensive cost template that identifies many areas of cost changes that may be associated with the training change. The purpose of the template needed to be threefold. First, it must serve as the planning tool that will help ensure key cost changes are not omitted. Second, it must serve as a framework that can enable us to cost a large number of alternatives. And third, it must consider the inputs into the calculation of costs. To develop this template, we looked to the literature that discusses costs in a systems analysis context.[18] We also examined specific applications of costing in systems analysis. Recent RAND research on costing changes in the active and reserve balance was critical in identifying key areas of cost considerations.[19] In particular, this work helped us determine how to define our key variables of resource factor, cost factor, and cost. Our definitions in Table 2.2 are based on this research.[20]

Table 2.2

Cost Model Definitions

Category	Definition
Resource factor	The changes in the particular resources involved in the alternatives. These include changes in manning type, manning quantity, equipment type, equipment quantity, and facilities that are generated by alternatives.
Cost factor	The dollar amounts for individual aspects of cost. These are costs per person, per piece of equipment, etc. There are typically a multitude of cost factors reflecting the variety of personnel, equipment, and facilities types.
Cost	Cost of the category is produced by multiplying a cost factor with a resource factor.

The RAND Report *Cost Element Handbook for Estimating Active and Reserve Costs* highlighted which cost changes need to be part of a cost template and how to specify the transition tasks involved with each change. This is very important because there are wide variations in transition costs.

We adapted the cost template developed in this research in order to reflect the kinds of resources, functions, and transitions that are relevant to the training context. One source for Army training-relevant factors was a series of cost analyses developed by TRADOC's Analysis Command (TRAC). A second source was a training cost effectiveness review contracted by

[17]Adele Palmer, *The Force Structure Costing Project Planning Phase Briefing*. Unpublished research.

[18]Gene H. Fisher, *Cost Considerations in Systems Analysis*, New York: American Elsevier Publishing, 1971.

[19]John F. Schank, Susan J. Bodilly, and Michael G. Shanley, *Cost Element Handbook for Estimating Active and Reserve Costs*, Santa Monica, Calif.: RAND, R-3748/1-PA&E/FMP/JCS, September 1990.

[20]Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance*, Santa Monica, Calif.: RAND, R-3748-PA&E/FMP/JCS, September 1990.

the Pentagon.[21] Another source was MODIA (Method of Designing Instructional Alternatives).[22] Table 2.3 is the general cost template for costing changes in training. The costs or savings that are produced in using this template are the cost changes and savings changes that result when a particular course alternative is implemented. It is a comparison of the current course to an alternative.

Table 2.3

General Cost Template

Cost Changes	Resource Changes						
		Manning		Equipment		Facilities	
	Activity Level	Amount	Type	Amount	Type	Amount	Type
NONRECURRING COSTS							
Civilian personnel cost							
• Acquisition							
• Initial training							
• Separation							
• Transfer							
Military personnel cost							
• Initial training							
• Transfer							
New training products							
Equipment procurement							
Equipment transfer							
Initial spares/stock							
Construction remodels							
RECURRING COSTS							
Civilian personnel cost							
• Replacement acquisition							
• Replacement training							
• Pay and allowances							
Military personnel cost							
• Replacement training							
• Student PCS							
• Student TDY							
• Instructor TDY							
Training product maintenance							
Fuel, oil, etc. (POL)							
Replenishment spares							
Ammunition							
Equipment maintenance							
Product distribution							
Product reproduction							
Facility maintenance							

NOTE: PCS is the abbreviation for Permanent Change of Station. TDY is the abbreviation for Temporary Duty. POL is the abbreviation for Petroleum, Oil, and Lubricants.

[21]Jesse Orlansky, and Joseph String, *Cost Effectiveness of Instruction in Military Training*, Alexandria, Va.: Institute for Defense Analysis, April 1979.

[22]M. B. Carpenter-Huffman, *MODIA: Vol. I, Overview of a Tool for Planning the Use of Air Force Training Resources*, Santa Monica, Calif.: RAND, R-1700-AF, March 1977.

Whose Costs Should We Consider?

A new costing method has to consider the effects outside the TRADOC schools because of the linkage between the training at the schools and the capability of the units. In addition, there is the potential for other organizations to be affected indirectly by training changes. Developing a way to consider the effects of changes on other organizations is a complex task. To aid in this task, we looked again to the literature in systems analysis. Systems analysis is an approach or way of looking at complex problems of choice under conditions of uncertainty.[23] The major contribution of this literature to the training resource analysis method was its focus on formulating the problem.[24] The formulation stage involves identifying critical assumptions about who and what is affected by change and how they are affected.[25]

While the general area of systems analysis helped point the way to the need for a broader definition of the affected organizations and the clarification of critical assumptions, an application of systems analysis research greatly aided in actually formulating a way to consider other organizations. This research is also the RAND work in costing the active/reserve balance.[26] One aspect of this research formulates how to plan the cost analysis.[27] Another part of this research developed a balance sheet that records the sources and dispositions of various activities and resources. If an activity is transferred to another organization, the balance sheet identifies this transfer, and the analyst can consider the resource effects of the transfer. This is particularly important in tracking the effects for other organizations. We adapted this methodology to the training context, and Table 2.4 is our template for the balance sheet.

We trace the activity changes for delivery, development, and support in order to determine how inputs (e.g., resources and functions) and workload change. There are four fundamental types of changes: activity/resource increases, activity/resource decreases, transfer from/to other courses or organizations, transfer from/to excess capacity. Targeted organizations are

[23]E. S. Quade, and W. I. Boucher (eds.), *Systems Analysis and Policy Planning: Applications in Defense*, New York: American Elsevier Publishing, 1968, p. 5.

[24]Systems analysis proceeds through a series of phases: formulation, data search, evaluation, interpretation, and verification. (See Gene H. Fisher, *Cost Considerations in Systems Analysis*, New York: American Elsevier Publishing, 1971, p. 22.)

[25]Quade and Miser (in *Handbook of Systems Analysis: An Overview of Uses*, New York: New Holland, 1985) provide an excellent discussion of the pitfalls in analysis concerning not realizing the key assumptions that "drive certain results."

[26]Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance*, Santa Monica, Calif.: RAND, R-3748-PA&E/FMP/FCS, September 1990; John F. Schank, Susan J. Bodilly, and A. A. Barbour, *Cost Analysis of Reserve Force Change: Non-Recurring Costs and Secondary Cost Effects*, Santa Monica, Calif.: RAND, R-3492-RA, May 1987; Michael G. Shanley, *Active/Reserve Cost Methodology: Case Studies*, Santa Monica, Calif.: RAND, R-3748/2-PA&E/FMP, 1991; Michael G. Shanley, *Guidelines for Planning the Cost Analysis of Active/Reserve Force Structure Change*, Santa Monica, Calif.: RAND, R-4061-PA&E/FMP, 1992.

[27]Michael G. Shanley, *Guidelines for Planning the Cost Analysis of Active/Reserve Force Structure Change*, Santa Monica, Calif.: RAND, R-4061-PA&E/FMP, 1992.

Table 2.4

Balance Sheet

Activities/ Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change
	Decrease	Increase	Transfer from (-)/to (+) Other Courses or Organizations	Transfer from (-)/to (+) Excess Capacity	
Delivery					
Development					
Support					

those specifically targeted and directly affected by the change. Other courses or organizations are those that may be indirectly affected by the change. For example, another course may be affected by the elimination of a training event in the baseline course. The activity changes for this other course need to be identified because there may be indirect resource and cost effects. And transfers from/to excess capacity represent changes that may or may not affect total resources. For example, a reduction in the length of a course results in the students spending less time at the school. The facilities are now available for other uses. However, this does not result in facility reductions. The surplus facilities produced by the alternative may be allocated to other uses or organizations. In this case, the surplus needs to be identified, but it is not a subtraction. We record the change in facilities as a transfer to excess capacity. Finally, the balance sheet lists the consequences of these four types of transactions—the net change. Table 2.5 defines the types of transactions that are recorded in the balance sheet for both the activity analysis step and the resource analysis step of the method.

Table 2.5

Definition of Balance Sheet Transactions

Category	Definition
Targeted organizations' activity/resource decrease	The subtraction of activities or resources from a targeted organization. Decreases can occur in the reduction, elimination, or change of lessons.
Targeted organizations' activity/resource increase	The addition of activities or resources to the targeted organizations. Additions can occur in the creation of a new lesson and/or lengthening of a course.
Activity/resource transfer from/to other organizations	The addition or subtraction of activities/resources from indirectly affected other organizations. Indirectly affected organizations may be other courses, schools, or any other organizations not directly targeted for change.
Activity/resource transfer from/to excess capacity	The addition or subtraction of activities or resources from the inventory of excess resources. A change in the course may create a reduction in the need for military manpower, but this manpower may not result in direct end-strength reductions.
Net change	Activities or resources added to or subtracted from the total Army pool of assets. The net change can be calculated by totaling the changes in the other four categories.

NOTE: Definitions of the categories are adapted from Glenn A. Gotz, Michael G. Shanley, Robert A. Butler, and Barry Fishman, *Estimating the Costs of Changes in the Active/Reserve Balance*, Santa Monica, Calif.: RAND, R-3748-PA&E/FMP/JCS, September 1990.

By answering these three fundamental questions and addressing the problems of the current methods, we have developed a new Army training cost method that has three objectives:

1. Evaluate training course alternatives.
2. Assess the effects of alternative implementations of training options.
3. Estimate changes in costs and savings.

Our unit of analysis is the course and its attendant events. This level of detail enables us to assess the proposed changes in training that will be implemented at this level. The method also evaluates alternative implementations of a change. This is important because there are a multitude of ways to implement one type of change, and each implementation has potentially different outcomes. Finally, the method calculates the changes in costs—both quantitative and qualitative. By tracing the specific changes in training, we are able to show the decision maker *what* is being traded in return for savings. In the next section, we present the specific steps that are involved in using this new method.

3. THE TRAINING RESOURCE ANALYSIS METHOD

TRAM is a five-step process used to cost alternative training strategies for an individual course. The five steps are:

1. Definition and specification of the baseline (the current course) and the alternatives. This step formulates the costing problem.
2. Analysis of changes in key activities. Understanding how activities change for the affected organizations, based on changes in workload, is necessary prior to quantifying resource changes.
3. Analysis of specific changes in resources: manpower, equipment, and facilities.[1] Resource consumption is driven by various activities, and the resources will change based on changes in activities generated by the alternatives.
4. Calculation of costs and savings of the alternatives. Cost factors are applied to specific resource changes for the various alternatives to determine cost and savings changes.
5. Presentation of results in a meaningful context—identifying cost flows, tradeoffs, and risks. Once costs are identified, the final step is to interpret the cost changes for the decision maker.

This section describes each step of TRAM. In this description of the method's analytic steps, we want the reader to be aware that the method is an iterative process. As new information becomes available concerning the training alternative, this information is factored into the analysis. For example, in conducting the activity analysis, there may be areas where key assumptions must be made concerning implementation of the alternatives. The analyst would proceed using these assumptions—making them explicit—and execute the rest of the steps. As additional information becomes available concerning the training change, the analyst would return to the method and revise the original input to reflect the new information.

The method can be used in two ways:

1. To screen a large number of alternatives.
2. To provide detailed cost estimates of a favored few alternatives.

If the purpose is to screen a large number of alternatives, we simplify the analysis by dividing the cost horizon into two parts—up-front adjustment costs, and stable recurring costs or savings. We then determine when and how the up-front adjustments are made and when the stream of savings or costs begins.[2] We demonstrate this screening use of TRAM in Section 4, which analyzes many different alternatives for the Armor Officer Advanced Course (AOAC).

If our purpose is to provide detailed estimates, then we want to examine carefully how the changes and costs are distributed across time and to consider external changes (e.g., force re-

[1]The definition of equipment includes supplies, contracts, fuel, and other materiel.

[2]We can simplify this further if we assume that each training option produces adjustments only in the first year of implementation and that recurring changes are at a constant annual rate for all years, extending into the indefinite future.

ductions, mission changes) that may affect the course and its alternatives. We demonstrate this detailed approach in Section 5, which focuses on one alternative for the M1/M1A1 Armor Crewman Course (19K OSUT).

DEFINITION AND SPECIFICATION OF THE CHANGE

TRAM focuses on changes in savings and costs that result from implementing alternative training strategies. The most important step in the method is the thorough definition of the current course (the baseline) and the proposed alternatives. Thorough definition of the baseline is critical, because the method uses the current course as the basis to cost training changes.

The Baseline

A critical document that supplies much of the necessary information for defining the baseline course is the Program of Instruction (POI). The POI is the formal course document that describes the training content, hours, class size, resources, and methods of instruction. There are a number of different instructional methods that are used in resident training. Table 3.1 lists these methods and their recommended instructor-to-student ratios. The POI is organized as a series of training events, and each event may involve one or more of these instructional methods.

Table 3.1

Instructional Methods and Recommended Instructor-to-Student Ratios

Method	Definition	Ratio: Instructor to Students
Conference/Lecture/Class	Employs directed discussion; instructor controlled	1:class*
Computer-based	Computer support of a training situation	1:20 or less
Small group	Group situation with presentation of problem or issue	1:20 or less
Demonstration	Use of an actual situation or portrayal to show and explain a procedure	1:20 or less
General practical exercise	A practical application of the actions specified in a lesson/event	Contingent on type
Practical exercise: 1	Performance-oriented exercise with actual equipment	1:6
Practical exercise: 2	Practical application outside the classroom, but not involving actual equipment	1:6
Practical exercise: 3	Exercises in classroom not involving equipment	1:20
Television	Live and video presentations	1:class
Seminar	Tutorial, designed to elicit and exchange information	1:20
Examination: General	Formal evaluation of student	Contingent on type
Exam: 1	Hardware-oriented performance test	1:6
Exam: 2	Non-hardware performance test	1:6
Exam: 3	Written test	1:class

NOTE: *Typical class size varies greatly depending on the course.

SOURCE: U.S. Army Training and Doctrine Command (TRADOC), *The Training Requirements Analysis System*, TRADOC Regulation 351-1, Hampton, Va., 1988.

The resources consumed by events include manpower (e.g., instructors), equipment (e.g., training devices and weapons), and facilities (e.g., lecture halls, ranges). When changes are made to a course, the events and their resources are affected. Table 3.2 lists two of the more than 100 training events in the POI for the entry-level course for Military Occupational Specialty (MOS) 19K, the M1/M1A1 Armor Crewman. The POI number is an index to the equipment, ammunition, and facilities used in the training event.[3] Most of the ammunition, equipment, and facilities requirements are listed in appendixes to the POI. The training event title provides a general description of the lesson's content. The academic hours by type of instruction designate the methods used in training, such as conference or lecture, computer-aided instruction, or practical exercises.[4]

Table 3.2

Program of Instruction: Example of Training Events

Program of Instruction Event Number	Event Title	Academic Hours by Type of Instruction	Scope of the Training Event
EI.50710	Drive an M1/M1A1 tank	10 Hours Total: 0.2 C 0.8 D 9.0 PE1	Each soldier will drive the M1/M1A1 tank 13 miles during the day and 7 miles at night on an established course.
EI.60807.5	Perform before-operation checks and services on an M1/M1A1 tank	7.5 Hours Total: 0.1 C 0.5 D 6.9 PE1	This consists of a block of training on the tanks where the soldier is taught to perform before-operation maintenance.

NOTE: C stands for conference, D stands for demonstration, and PE1 stands for practical exercise using actual equipment or weapons.

SOURCE: U.S. Army Armor School, *Program of Instruction, 19K10-OSUT Course M1/M1A1 Armor Crewman,* Fort Knox, Ky., June 1990.

The Alternatives

Course alternatives may be generated in a couple of different ways. The formal system presently used by the Army is the Systems Approach to Training (SAT). SAT is the system to ensure performance requirements are integrated into training.[5] Once the SAT process reaches the development and implementation stage, the Training Requirements Analysis System (TRAS) documents the plans and support requirements for a course. It is through

[3]EI.50710 is the POI number for the tank driver training event. The last two digits of the number refer to the length of the event in academic hours.

[4]Currently the POIs are not automated. We converted POIs to a simple spreadsheet that included the event name, department, academic hours, methods of instruction, equipment, ammunition, and facilities requirements. This aided us later in quickly determining the major effects of alternative POIs generated by the task analysis. It would simplify the computations and tracking changes in the POI if the Army would computerize the POIs. In addition, if all POIs were automated, using TRAM for tracing changes for more than one course at a time would be greatly simplified.

[5]*Systems Approach to Training,* TRADOC Pamphlet 351-4 and computerized information system. SAT is a five-stage process: evaluation, analysis, design, development, and implementation.

the TRAS process that POIs are created and revised.[6] TRAM can use POIs generated through this traditional process or POIs generated by a second method developed by RAND. This method is the job analysis, described earlier, and the output of the job analysis are alternative POIs. However, it is critical that alternative POIs exist in order to cost changes at the course and event levels of detail.

Once the alternative POIs exist, there are several questions that need to be answered:

- Is there a change in the student population? This includes specification of class size as well as targeted student groups (e.g., active or reserve, other branches, foreign students).
- Is there a change in course frequency? This includes adding, dropping, or consolidating courses and identifying effects on other courses.
- Which training events will be affected by the change? This includes identifying changes in duration and whether there are changes in methods (including new training technology, new equipment, or facilities).
- Who will be conducting the training? This includes identifying whether training will be transferred to units, other schools, or civilian locations.
- When will the changes take effect? This includes determining the budget year the decision will be implemented and when key transition activities may occur.[7]

There may be aspects of these questions that cannot be answered. As a result, assumptions may need to be made in order to proceed with the analysis.

Assumptions

Any assumptions need to be made explicit for the decision maker to understand the extent and limitations of the analysis. Assumptions may have to be made in a number of different areas, such as the scope of effects (i.e., which organizations are directly and indirectly affected by the training changes), timing of the alternatives, and potential future changes in Army training. Assumptions may need to be changed as we obtain additional information.

ACTIVITY ANALYSIS

In the activity analysis step, we determine which activities change, for whom they change, how they change, and when they change. The activity analysis focuses on the changes that occur in the areas of delivery, development, and support.

[6]*The Training Requirements Analysis System*, TRADOC Regulation 351-1 and computerized information system. There are three supporting documents for the TRAS system. The Individual Training Plan (ITP) describes the school's plan to satisfy training requirements. The Course Administrative Data (CAD) is prepared for each resident course. The CAD is used for programming student load and instructor manpower authorizations. The Program of Instruction (POI) is the final document produced by the TRAS system. It is submitted six months prior to course implementation or course revisions.

[7]We want the costs and savings to reflect the general purchasing power of the dollar at the time of the decision.

There are three things to accomplish in the activity analysis. First, we need to identify which specific activities change; the alternative POIs are the starting point for this aspect of the activity analysis. Second, we need to identify which organizations are directly and indirectly affected by the alternatives. This is critical because there are activity, resource, and cost changes associated with indirect effects. Third, we need to translate activity changes into changes in workload factors so we can proceed to the next step of the method—quantifying the changes in resources.

Identifying Affected Organizations

Changes in the POI will inform us of many of the school organizations involved in the training change.[8] However, we need to determine if other organizations should be added to the analysis. There are several ways other organizations can be affected by a training change. There are effects of changes in mission, doctrine, or activities, and there are effects of transfers of resources.

Mission Changes. Changes in mission may occur due to formal changes in the school's mission statement. For example, a future change in the Armor School mission may be the transfer of a course to another installation (e.g., elimination of AOAC and creation of a combined arms course at Fort Benning).

Doctrinal Changes. Doctrinal changes may result in changes in the overall force structure or changes in tasks for particular MOSs. For example, there is a planned change to merge the Cannon Fire Direction Specialist (13E) and the Tacfire Operations Specialist (13C) due to the similarity of their functions. This planned change needs to be part of the analysis.

Activity Changes. Changes in activities can affect other courses or training departments. For example, if a shared field training exercise is eliminated for one course, then we need to identify other courses that share this exercise because they are also affected by this change.

Resource Changes. Organizations can be indirectly affected by a training change through the increase, decrease, or transfer of resources from one organization to another. For example, a greater use of simulators in the 19K M1/M1A1 Armor Crewman course may free up a quantity of M1/M1A1 tanks. These extra tanks may be transferred to reserve units. As a result, there may be major training delivery activity changes for these reserve units.

Identifying affected organizations is usually an iterative process. We focus on the organizations targeted for change such as the school or, if training is distributed, the specific units involved. We then ask a series of questions that are designed to identify organizations that are potentially affected by the change in training. As we proceed through the analysis we may have omitted an organization that is affected. We would need to return to our questions and determine if there are still additional effects. Table 3.3 lists these questions and serves as a guideline for ensuring identification of affected groups. The questions are organized by major activity area and by the types of changes that could potentially affect other organizations.

[8]The POI can also point to other potential courses that may be affected by the training change because it lists course prerequisites.

Table 3.3

Identifying Other Organizations Involved in the Change

Type of Change for Targeted Groups	Questions
Delivery mission	Are there potential training mission changes? • What schools, departments or courses are involved?
Delivery doctrine	Are doctrinal changes planned? • At what level and where are these changes—military occupation, unit (TOE or TDA), training school?
Delivery activity	Are other organizations now responsible for the training? • Which ones? • Will other groups of courses be affected? • Which ones? Are other courses affected? • Which ones—prerequisites, follow-on, etc.?
Delivery resources	Are resources being transferred to other organizations? • Which ones? • Where are these coming from and where are they going? Are resources being added or eliminated? • Which ones? • Which organizations or courses are affected?
Development mission	Are there mission changes that would affect training? • Which school training is affected? • Which unit training is affected?
Development doctrine	Are doctrinal changes planned that would affect training development? • Which individual training courses may be affected?
Development activities	Are development changes affecting other courses or schools? • Which schools or courses are affected?
Development resources	Are new training products being added? • Which other courses can use the products? Are old products being eliminated? • Which courses will be affected?
Support mission	Do training changes affect other missions such as personnel? • Which missions are affected and where?
Support doctrine	Do doctrinal changes have any effect on support groups? • Which ones?
Support activities	Are there changes in maintenance activities? • What maintenance levels are affected? Do the training changes affect overhead? • Where is overhead affected?
Support resources	Are resources being transferred? • Which resources? • What organizations are affected? • Where are these resources coming from and where are they going? Are resources being added that could be used for other purposes? • Which resources? • What organizations can use the resources?

As we proceed with the analysis, we may have to add or modify the affected organizations and the resource changes. However, by attempting to answer these questions, we have examined a wide range of possible consequences of the change that may affect the cost outcomes.[9]

Translating Activity Changes into Changes in Workload Factors

It is important to understand both the organizations involved in the training change, their activities, and their workload factors in order to develop comprehensive cost analyses. In other parts of the Army, many activities are measured by operating tempo (OPTEMPO). Examples of OPTEMPO factors are flying hours, tank miles, or truck miles. Costs are then developed using these factors, and a typical OPTEMPO cost is the cost of fuel per tank hour. Costing training is different, and most of the activities in the training context cannot be expressed in OPTEMPO terms. Training activities have a variety of different workloads that are then measured by various workload factors, which are part of the resourcing equations or resourcing processes. For example, the principal workload factor for the schools is student input. Student input is frequently transformed to a student load factor, which is the average number of students in the course per training day, week, or year. The schools have a variety of other workload factors that determine the resources provided.[10]

In the activity analysis, we translate these activity changes into changes in workload and workload factors. We use the balance sheet to record the changes in workload that accompany the changes in training, and we separately trace the workload changes for delivery, development, and support.

Delivery Activities' Workload Factors. Assessing the workload and activity changes for training delivery starts with student input. This is the number of students forecasted to attend the course in a particular year. The POI's optimal class size is then used to determine how many iterations of the course will be given. So, if optimal class size is 100 and student input is forecasted at 500, there will be five iterations of the course. If the course we are analyzing is projected to have a significant drop in student input over the next few years, we would want to include that student reduction in the activity analysis.[11] A drop in student input numbers has a significant effect on many of the activities associated with the production of the course. In particular, it affects the number of times per year a course is given. This, in turn, affects instructor hours and other workload factors, and the resource consumption. With a planned drop in student input, course costs will be reduced without any changes in training strategies.

[9]We provide assistance for answering these questions in Appendix A by identifying organizations involved in training.

[10]For example, structure load determines the number of training companies and platoons for basic and OSUT training; estimated time values determine the number of training developers; monthly maintenance standards determine the number of maintenance personnel required for specific equipment; and training days determine the number of major weapon systems required.

[11]An important source of information concerning student input and student load is the Army Training Requirements and Resources System (ATRRS).

We first need to determine how the alternative changes the course length and the distribution of academic hours among the training departments. Table 3.4 is an illustration of changes in academic hours for an alternative POI for a hypothetical course at Fort Knox. The entries in the cells represent changes from the baseline course for each of the training departments. The overall reduction in the course length is 120 hours (three weeks).

Table 3.4

Changes in Instructional Methods and Academic Hours

Method of Instruction	Deputy Assistant Commandant (DAC) Hours	Maintenance Hours	Weapons Hours	Command & Staff (C&S) Hours	Total Hours
Conference	-1	-7	-13	-60	-81
CBT	0	-10	-10	-10	-30
Demo	0	-3	0	-6	-9
Total	-1	-20	-23	-76	-120

NOTE: We can add and subtract these hours because the instructor staffing standard is the same across all departments.

We now need to determine the annual change in the student load. The baseline student load is the number of student man-years that are currently devoted to the course. We determine how student load changes as a result of reducing the course length from 20 weeks to 17 weeks. If our baseline student load is 200 student man-years and we reduce the course by three weeks, our new load is 170 man-years.[12] We have reduced the training time of students at the installation by 30 student man-years. If we are using the detailed application of TRAM for a favored alternative, we would want to include forecasted changes in student input for the course over future years.[13] Table 3.5 illustrates how we would trace a decline in student input and load over future years.

Table 3.5

Future Years Reduction in Student Load

	FY 92	FY 93	FY 94
Student input*	500	400	300
Baseline course load (20-week course)	200	160	120
Alternative load (17-week course)	170	136	102
Student load difference between baseline and alternative	-30 man-years	-24 man-years	-18 man-years

NOTE: *Student input is the total annual number of students forecasted to attend the course. Load is represented as student man-years.

We also need to know how the changes in length translate into changes in instructor hours. The number and type of methods and the ratio of instructors to students is the basis for in-

[12]If we assume an annual input of 500 students and the course is 20 weeks long, the load is 200. If the alternative reduces the course by three weeks and we have the same student input, then the new load is 170 man-years.

[13]ATRRS contains current-year student input and forecasted input for the future four years.

structor contact hour (ICH) computations.[14] TRAS prescribes the size of classes, sections, and groups required by equipment or facilities, scheduling constraints, safety requirements, and complexity of the lessons for each method (e.g. conference, demonstration, practical exercise, etc.).[15] For example, a one-hour conference may require only two sections of a 100-student class. One instructor would be required for each section. The instructor contact hours would be 1 instructor × 2 sections × 1 hour, or 2 instructor contact hours.

We multiply the number of course iterations for the year by the number of ICHs required for each department for one course iteration. Table 3.6 summarizes the changes in annual instructor contact hours by Fort Knox training departments for our hypothetical course.

Table 3.6

Annual Changes in Department ICH Hours for an Alternative POI

Method of Instruction	DAC ICHs	Maintenance ICHs	Weapons ICHs	C & S ICHs	Total ICHs
Conference	-4.0	-59.2	-272.0	-600.0	-935.2
CBT	0	0	0	-120.0	-120.0
Demo	0	-70.4	-48.0	0	-118.4
Total	-4.0	-129.6	-320.0	-720.0	-1,173.6

If we are using the detailed application of the method, the student input would change the number of iterations for future years. We would trace the annual changes in instructor contact hours by comparing the changes in the baseline over future years to the changes in the alternative. The approach would parallel how we traced the changes in student load.

It may be that we are transferring academic instruction to other locations. For example, one week of the instruction eliminated from the school may be transferred to field units. In transferring training to field units, it is TRADOC's plan to establish learning centers that would be the focus of individual training in the field. These learning centers would be under the direction of TRADOC and would be TDA units. Table 3.7 shows an activity balance sheet for a case of transferring training to these field learning centers. One hundred twenty academic hours are being reduced at the school, and 40 of those hours are being transferred to learning centers in the field. This creates a reduction of 120 academic hours from the course and a transfer of 40 academic hours to the learning centers. The learning centers may train these 40 hours differently than the way they are trained in the school, and we need to estimate the approximate number of ICHs for the learning centers.[16] In order not to add or subtract "apples and oranges," we enter the changes for the school and the learning centers on separate lines in the balance sheet. If a TOE unit were to conduct the new training, we would not use ICHs for the change in activity because the TOE units do not measure their training activities by ICHs. We would need to know how the TOE unit plans to train these distributed hours. It may be that the unit integrates the training into on-the-job training

[14]ICH summaries are reported separately in the ICH Computation Worksheets.

[15]TRADOC Regulation 351-1, *The Training Requirements Analysis System* (TRAS).

[16]We would use the Training Requirements Analysis System (TRAS) to estimate these ICHs. The TRAS requirements include information on methods and instructor-to-student ratios.

and does not require any additional resources. Alternately, the unit may need additional instructors from TDA units to conduct the training.

Table 3.7

Activity Balance Sheet: Delivery

Activities/ Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change
Delivery	School Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity	
Academic hours					
• School	-120 hours				-120 hours
• Learning centers		+40 hours			+40 hours
Total ICHs					
• School	-1,173.6 ICHs				-1,173.6 ICHs
• DAC	-4.0 ICHs				
• Maintenance	-129.6 ICHs				
• Weapons	-320.0 ICHs				
• C&S	-720.0 ICHs				
• Learning centers		+400.0 ICHs			+400.0 ICHs
Student load	-30 student years			+30 man-years	

Development Activities' Workload Factors. The training departments are responsible for much of the subject matter development. This activity is included in the instructor staffing standards or in special manpower additives that reflect specific development activities of the training departments.

The Directorates of Training and Doctrine (DOTD) at the schools focus on the development of training products and finalize the input from the training departments. The major workload factors for the training development area are the estimated man-hours required to develop new training products and to sustain existing training products. Training development products include computer-based instruction, simulations, written training packages, training aids, examinations, and videos. In addition, training development maintains the formal course documents—including the POI.

Currently, each major training product has estimated time values that designate the number of man-hours required to develop or maintain the product. In tracking activity changes in development, we need to know both the number and type of new products (for both new development and sustainment) and the change in old products that no longer have to be maintained. Table 3.8 illustrates how we would track the changes in development products. In this example, we are eliminating ten conference products and five computer-based instructional products and are replacing them with ten computer-based instructional products and one videotape product. The increase column is important because it designates the transition development activities for the alternatives. The net change column is important because it shows the difference in the number of instructional products that need to be sustained. We then use the new product requirements and the changes in sustainment activities and apply

the training development estimated time values per product to determine how many training development man-years are required for this change.

Table 3.8

Activity Balance Sheet: Development

Activities/Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change
Development	School Decrease	School Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/ to (+) Excess Capacity	
• Conference products					
• Computer products	-10				-10
• TV/Video products	-5	+10			+5
TDY man-years					
• Conference products					
• Computer products	-1 man-year				-1 man-year
• TV/Video products	-.5 man-year	+2 man-years			+1.5 man-years

If the changes are being phased in over time or if we are using TRAM's detailed application to determine the changes, we would trace the changes in development activities over time in a manner similar to that we used in analyzing training delivery. We would determine when the new products would be required and when the development would need to commence. We would also determine when old products could be phased out. Table 3.9 summarizes development activity changes over a period of years.

Table 3.9

Activity Balance Sheet: Development in Future Years

Activities/Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change
Development	School Decrease	School Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity	
FY 92					
• Conference products	-10				-10
• Computer-based products	-5	+10			+5
• TV/Video products		+1			+1
FY 93					
• Computer-based products		+9			+9
• Conference products	-20				-20
• TV/Video products		+20			+20
FY 94					
Paper-based products	-15	+10			-5

Support Activities' Workload Factors. Tracing the changes in support activities is more difficult because support activities exist at many different organizational levels within the schools. Support activities include such functions as maintenance, housing, scheduling, ad-

ministration, and supply. Support activities with the same workload factors may have different demands for resources. For example, supply operations may change in a linear fashion based on student load. However, administrative activities may also be based on student load, but the demand for administrative activities changes only when there are large changes in student load, as illustrated in Figure 3.1.

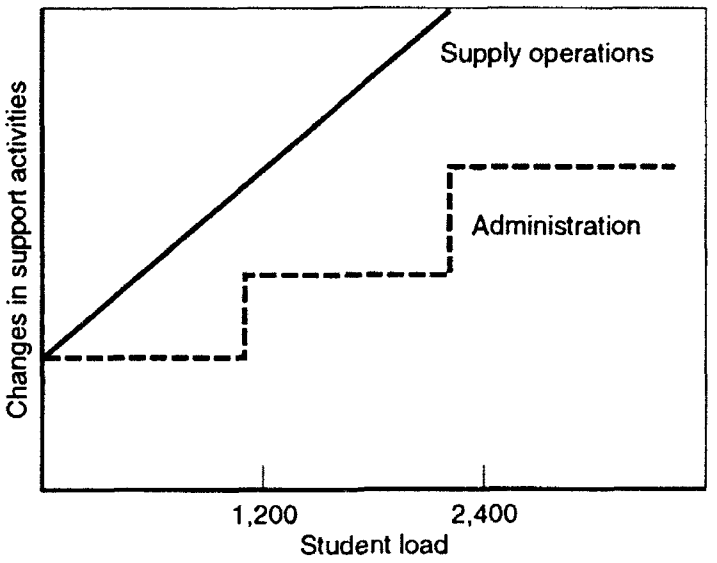


Figure 3.1—Differences in Support Activities

Several sources indicate that many support activities change in a step-function manner rather than in a linear fashion. First, many of the supervisors of these functions note that their workload may be the same for one student as it is for 50 students.[17] Second, the workload ranges for establishing the cost-estimating and manpower-estimating relationships are extremely large, which indicates that, for some of the activities included in the individual Army Structure Management Codes (AMSCOs), their relationship to workload may not be linear. Third, a review of historical TDAs for several of these support functions shows increases only when there are large increases in student load.

In order to project changes, we need to understand how these support activities will change as a result of changes in workload generated by a course's training alternatives. The analyst needs first to first gain a thorough understanding of the organization and activities of the school. Each training installation has a different mix of support activities, and we need to develop a list of support activities that reflects the particular training installation involved in the change. Because the application of our method in this document is based on the Armor School, we developed a listing for its support activities. To develop our list, we started with the AMSCOs and then went several levels lower by using current organization charts to

[17]Directorate of Engineering and Housing, U.S. Army Armor Center and Fort Knox, Fort Knox, Ky., interview with author, July 1991; Directorate of Resource Management, U.S. Army Armor Center and Fort Knox, Fort Knox, Ky., interview with author, December 1991.

identify the specific activities within the AMSCOs.[18] We then examined all the staffing standards and guidelines to determine the major workload factors for the activities within the AMSCOs. Table 3.10 is the comprehensive listing of the Armor School support activities. The table shows that more than one support activity is categorized within an AMSCO.

Table 3.10

Training Support Activities

Support Activities	AMSCO	Major Workload Factors
Training brigade		
• Brigade maintenance	814761	Vehicles, monthly maintenance hours
• Brigade and group management	814761	Structure load
Training departments	814711	
• Management	814723	Number of military occupational specialties (MOS),
• Administration	814731	military qualifications standards (MQS), instructors, student load
Plans, training, and mobilization	814731	Frequency of classes
• Audiovisual/Literature production	815790.1	New and revised courses, MOSs, and MQSs
• Training support to units	819731	New equipment fieldings, doctrine changes
• Mobilization	815796.v	Combat units supported
Evaluation	814771.6	Number of different courses
Training and doctrine		
• Learning center	814772	Student population
• Faculty/Staff training		Instructor load/instructor turnover
• Publications		Training products
Engineering		
• Property repair and maintenance	815794.j-m	Square footage and acreage
• Housing	815796.h	Frequency of classes/installation
		Population distribution in man-years
• Construction	815796.l	Programmed construction
• Automation	815796.p	Number of contracts
Special staff	815796.t	Installation/student population
• Installation management	815796.n	Installation/student population
Logistics	815796.b	Installation/student population
• Maintenance	815796.c	Equipment utilization (e.g., miles, hours) and age of equipment
• Transportation	815796.d	Troop movements and relocations
• Food service	815796.f	Student population/installation population
• Procurement/Contracting	814731	New orders, contracts
Reserve support	815796.q	Reserve student input
Personnel and community support	815796.s	Installation population
• Army continuing education	879732	Continuing education courses
• Personnel support	815796.g	Installation population
Resource management	815796.u	Installation assets (including manpower)

NOTE: Data provided by TRADOC's Deputy Chief of Staff for Resource Management enabled us to examine the Armor School's expenditures from FY 81 through FY 89. Manpower was the most significant slice of expenditures for the majority of support activities.

[18]The definitions and resourcing equations based on the workload factors are found in the staffing standards, the work center standard computation, or workload factor computations. Department of the Army, Deputy Chief of Staff for Personnel, *Manpower Staffing Standards System*, Regulation 570-5, Washington, D.C., June 1989.

We also need to determine if the workload will change for the various support activities, how it will change, and if it will be transferred somewhere else as a result of the alternatives. In many cases, support activities will not be affected by a training change. This is because of the "step-like" nature of the relationship between support activities and their workload factors.[19]

The way we determine whether support activities may change is to review the school's support function list and the attendant workload factors and to determine if any of these workload factors might be affected by the alternatives. For example, if a training event that uses M1A1 tanks is eliminated, and the annual miles reduction is 100 miles, this translates into potentially lower maintenance activities. Or, if the course is changing from a Permanent Change of Station (PCS) assignment to a Temporary Duty (TDY) assignment as a result of reducing the course length to less than 20 weeks, there is a potential impact on base housing and logistics, because the soldier is not relocating his family to the school.

Table 3.11 is an example of potential changes in support activities. The balance sheet notes the change in workload for these support functions and uses the workload listed in Table 3.10. In this example, we eliminated 100 miles of tank driving per year and changed the course from the PCS assignment to a TDY assignment. This PCS to TDY change means that officers and their families will not be relocating to Fort Knox, which means a reduction in the number of officer relocations.[20] However, now the officers need either to be provided with food and housing or to be given temporary duty allowances.

Table 3.11

Activity Balance Sheet: Support

Activities/Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change
Support	School Decrease	School Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity	
Maintenance	-100 M1A1 miles				-100 M1A1 miles
Housing • Family housing	-200 family years				-200 family years
• Temporary		+200 officer years			+200 officer years
Transportation	-500 officer relocations				-500 officer relocations

[19]To determine whether a step is reached, the analyst needs to examine historical support workload against authorized resource levels. In most cases this information does not exist. As a result, the supervisors of these functions need to be consulted to determine whether the change results in a different step.

[20]Table 3.11 highlights the difference in workload factors for different activities. For example, changes in housing are driven by changes in man-years. However, changes in officer relocations are driven by total student input.

Having identified all the activity changes and the key organizations affected by the alternative POIs, we now document the changes in resources. The resource analysis uses the results from the activity analysis and traces the resource changes. Figure 3.2 illustrates how the activity analysis provides the foundation for the resource analysis.

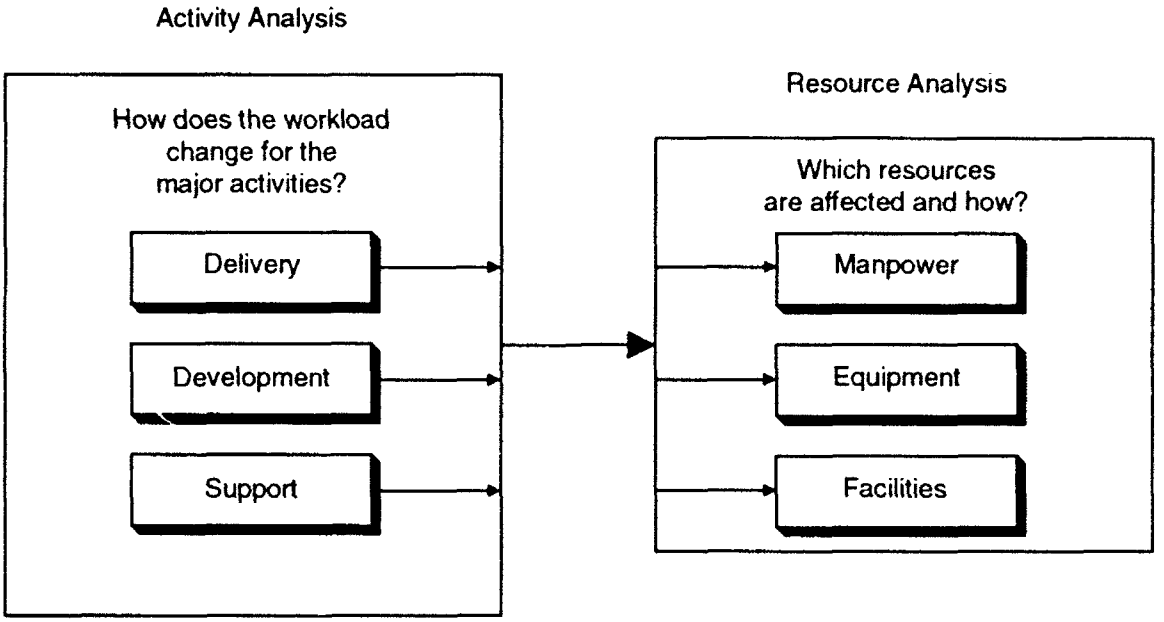


Figure 3.2—Translating Activity Changes into Resource Changes

RESOURCE ANALYSIS

Our first step in the resource analysis step is to summarize the activity balance sheets for each alternative. Table 3.12 is the collection of the balance sheets used in our discussion of the activity analysis. In this summary of activity changes we also want to consider whether these activity changes may be one-time/transition activities or whether they are recurring changes in activities. We enter our initial estimates as to the one-time or recurring nature of the activities in the column "Type of Activity."

Once we have summarized the activity changes from our activity balance sheets, we then have to address three key resource considerations. These considerations are: level of resources, transition resources, and sources of resources information.

Table 3.12

Catalogue of an Alternative's Activity Changes

Activity/Workload Changes	Type of Activity	
	One-time/Transition?	Recurring?
DELIVERY		
Installation course length (-120 hours)		X
Field unit course length (+40 hours)		X
Student load reductions		X
School annual ICH changes (-1,173.6 ICHs)		X
• DAC (-4.0 ICHs)		
• Maintenance (-129.6 ICHs)		
• Weapons (-320.0 ICHs)		
• C&S (-720.0 ICHs)		
Learning center ICHs changes (+400 ICHs)		X
DEVELOPMENT		
New product development		
• Computer-based products (+10)	X	
• Videotaped instructional products (+1)	X	
Development sustainment		
• Conference products (-10)		X
• Computer-based products (+5)		X
• Videotaped instructional products (+1)		X
SUPPORT		
Maintenance (-100 M1A1 miles)	X	X
Family housing (-200 officer family years)	X	X
Temporary housing (+200 officer man-years)	X	X
Transportation (-500 officer relocations)		X

Level of Resources. There are three different levels of Army resources: requirements, authorizations, and actuals. The values of these three resource levels differ. Requirements reflect wartime levels of resourcing. However, requirements do not match resource levels that appear in the Defense budget. Actuals are what is currently on hand and are difficult to use in analyzing training changes because they can change daily. Authorizations correspond to resources in the program and budget years of the Planning, Programming, Budgeting, and Executing System (PPBES). As a result, authorizations are likely to be better at predicting the program and budget consequences of a training alternative. If possible, the authorization levels of resources should be used.

Transition Resources. Identifying transition resources is a critical step in the method because not all transition tasks are readily apparent. Transition tasks can include activities to add, eliminate, or transfer personnel; the procurement and transportation of new or excess equipment; and the construction or modification of facilities. Transition activities and their attendant resources are highly variable and depend on the specific type of change and the characteristics of the change. Also, different implementations of the same alternative may have widely varying transition costs. For example, if part of a course is distributed, the method of distribution is particularly important for determining the transition costs. If the method is paper, the costs are likely to be fairly low. However, if the method is teletraining, the transition costs may be very high or the expenditures may already have been made—depending on the extent teletraining currently exists at the learning centers.

Sources of Resource Information. The activity analysis and the related workload factors highlight specific areas of change. However, in the resource analysis step, we need to examine other types of information that further delineate the transition resources and the types and quantities of resources used by the various activities. For example, an activity's TDA will tell us specifically whether the affected personnel are military or civilian and their respective grades or ranks. The TDA will also tell us the type and amount of equipment that is authorized for the activity. Budgets can tell us the amount of supplies and materiel. Installation resource management reports provide data on the amount and distribution of manpower by facilities' square footage.[21]

In the resource analysis, we focus on the specific number and type of one-time and recurring changes for manpower, equipment, and facilities. Table 3.13 defines these resources, and we use available resourcing information and factors to determine the changes in resources and record these changes in the balance sheets.

Table 3.13

Resources

Development/Delivery/Support Resources	Definition
Manpower • Changes in quantity • Changes in type	The number and type of personnel that comprise the organization, including the distinction between active and reserve, full-time and part-time, military and civilian, and officer and enlisted. Other distinctions may also include job classification, grade level, and years of service.
Equipment/Materiel/Supplies • Changes in quantity • Changes in type	The number and type of equipment, materiel, and supplies changes in an organization's equipment inventory, including major weapon systems, trucks, spare parts, fuel, and ammunition, etc.
Facilities • Changes in quantity • Changes in type	Changes in an organization's facility quantity and type—such as ranges, classrooms, or other facilities required by the organization to perform its function.

The balance sheets for the resourcing step are different from the activity analysis balance sheets in one important respect. There is an additional column to record whether the change in resource is a one-time change or a recurring change. This recording of the nature of the resource change helps us later in calculating the costs.

Manpower Resources

There are two categories of manpower, civilian and military, and training alternatives can change the number or composition of either of these categories. However, civilian and military manpower need to be analyzed separately because the Army manages these groups differently. On the one hand, the management of civilian personnel is decentralized. TRADOC is allotted an annual budget for civilian manning and may vary the civilian manning within established tolerances. The number and cost of civilian changes can be attributed to the

[21] Appendix A provides additional information concerning sources of data for resources.

changes that occur within an organization due to training alternatives. On the other hand, military manpower is managed centrally, and personnel numbers and composition are governed by separately imposed end-strength limits for each component (e.g., active and reserve). As a result, changes in military manpower do not occur unless end-strength limits are changed. If end-strength limits are not adjusted, the changes in manpower extend beyond the organizations directly targeted for the training change.

TRAM focuses on the effects of training changes for the Army as a whole and not just TRADOC, and the current climate for the Army is one of end-strength reduction. In this context there are three consequences that can result from a change in military manpower caused by a training alternative:

1. The surplus military manpower that results from a training change that eliminates spaces (jobs) may be allocated to undermanned organizations.
2. The increased military manpower that results from a training change that requires additional spaces may come from other organizations within the Army.
3. The surplus military manpower that results from a training change that eliminates spaces may be offered for future end-strength reductions. In this case, either manpower in the grades that correspond to the eliminated spaces may be reduced or the end-strength may be decreased by reducing accessions.

To account for changes in military personnel, we summarize military manpower changes separately for the decision maker. In this summary we are explicit about our assumptions concerning which of the three consequences may result from the training change. For example, if we assume that military personnel whose spaces are eliminated as a result of the change are transferred rather than deleted, we record these changes as transfers to other organizations. We also note that there is the potential to reduce end-strength either through the elimination of manpower in grades that correspond to these spaces or through reduced accessions.

This approach differs from the requirements set forth by TRADOC's Deputy Chief of Staff for Analysis (DCSA). The DCSA considers end-strength as fixed because the reduction of military manpower is outside TRADOC's scope of responsibility. TRADOC Pamphlet 11-8, *Studies and Analysis Handbook,* sets forth the following guidelines:

> Personnel resource impacts should be discussed in terms of numbers of people rather than dollars. Congress appropriates a certain amount of money for Army personnel. This buys us a fixed end-strength which can only be changed by Congress. . . . But remember, the Army has never cut manpower as a result of a system (or training) decision. It has only been done because of Congressional budget cutting.

However, these guidelines are designed for TRADOC decision makers. TRAM is designed to analyze the effects of training changes on the Army as a whole, and Army military manpower is being reduced. Changes in training can have an effect on the net Army end-strength—either through reduced trained personnel or through reduced accessions. In the current climate it is important to capture the potential consequences of changes in military manpower, and the balance sheet approach enables us to record the effect of changes on end-strength.

To calculate the specific changes in number of personnel spaces, we use the manpower resourcing standards. For example, in training delivery, the ICHs determine the number of department instructors required to teach the course.[22] We use the resource equation for instructors and calculate the changes in instructors generated by the changes in the ICHs. If the monthly departmental ICH reduction is 189 hours, we can reduce two instructors.[23]

Other activities such as training development and personnel also have personnel standards. However, the majority of MS3 standards are in the delivery area and cover various training departments and their overhead requirements. Those activities that do not have MS3 (Manpower Staffing Standards System) standards are manned according to staffing guidelines.[24]

We use the TDA authorizations to determine the type (civilian or military) and grade level of the instructors. We need this information in order to identify the potential types of military personnel that are available for other assignments and to determine the pay categories of civilian personnel.

The POI tells us the modal student grade, and a report produced by ATRRS, the Student Summary Report, tells us the distribution of active and reserve students. Students are affected by a training change when the course is shortened or lengthened. If a course is shortened, those students become available for assignment.

Table 3.14 illustrates a balance sheet for recording changes in manpower—both civilian and military. The manpower balance sheet lists all the manpower changes for delivery, development, and support. As already noted, it also has a column to record whether the change is potentially a one-time (transition) change or a recurring change. In this case, we record the reduction in instructors and the savings in student manpower as transfers to other organizations that are currently understaffed. The changes in military instructors require one-time transition costs for the reassignment of these military personnel. The changes in students are recorded as recurring because in the future there is more available manpower to be assigned to operating strength.[25] However, in the case of both students and instructors in a climate of manpower reductions, these spaces may be offered to decrease end-strength levels.

The civilian changes are shown as a net change and involve one-time separation resources and recurring savings of resources (their pay and benefits).

[22]The resourcing standard for all officer courses at Fort Knox is 66.62 + 1.54 (monthly instructor contact hours)/145. The 66.62 is a fixed factor and the 1.54 represents the total time the instructor needs for each contact hour. The monthly contact hours are the annual ICHs for the department divided by 12. 145 represents the available man-hours each month. Appendix A lists the current MS3 standards that exist for other activities.

[23]188*1.54/145 = 2.

[24]Appendix A details those departments which have MS3 standards and those that are manned according to staffing guidelines.

[25]End-strength governs the number and composition of the force. Some fraction of active end-strength is always in transit beween assignments, in resident training, or otherwise not available for assignment to authorized positions. The TTHS account (transients, trainees, holdees, and students) provides authorizations for personnel not presently in the operating end-strength. Training course length can affect the number of authorizations allocated to the TTHS account. If the length of a course can be reduced, then manpower assigned to the TTHS account may be reduced and be assigned to operating end-strength.

Table 3.14

Manpower Balance Sheet

Activities/Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change	O.T./Rec.*
	School Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity		
Delivery						
• Military (grade)	-3 O-2*	+2 O-2	+1 O-2			O.T.
	-3 E-4*		+3 E-4			O.T.
• Civilian (grade)	-7 GS-11				-7 GS-11	O.T./Rec.
Development						
• Military (grade)						
• Civilian (grade)						
Support						
• Military (grade)						
• Civilian (grade)						
Students	-30 O-2 student man-years		+30 O-2 man-years			Rec.

NOTE: *O=officer, E=enlisted, O.T.=one-time, Rec.=recurring

Equipment/Materiel/Supplies Resources

The school, unit, or other organizations' equipment inventory includes the major weapon systems, support equipment, maintenance support and test equipment, training equipment, other major end-items of equipment (e.g., trucks), spare parts, and munitions. In the context of a change in training, equipment changes consist of the addition of equipment or the transfer, sale, storage, or disposal of equipment.

Changes in equipment that result from a change in training require documentation in the equipment resource balance sheet. The list of new equipment will facilitate the calculation of one-time equipment costs of a training change. Documenting the source or disposition of major equipment helps confirm or correct how we have defined the scope of the problem. For example, if equipment is transferred from the school to active or reserve units, the old equipment of one unit may become the new equipment of another. This requires consideration of the changes in indirectly affected organizations in order to measure the consequences of this transfer of equipment. Also, documentation of equipment changes resulting from a change in training will help identify the possibility of a significant change in the recurring costs of equipment operation. This can occur because each type of equipment has its own operating and support costs.[26]

Table 3.15, an example of an equipment/materiel/supply balance sheet, highlights several important points. In this example, there is the requirement for new computer training equipment at the learning centers. These new computers must not only be procured, but they also need to be maintained in the future. The last column of the balance sheet designates that this resource change is both one-time and recurring. Second, there is a reduction of two M1/M1A1 tanks at the school. In order to determine the number of tanks that could be

[26]Resourcing information for equipment is further explained in Appendix A.

reduced by our alternative, we had to know how the Army determines the number of M1/M1A1 tanks authorized for the school (the resourcing equations) and the current inventory of M1/M1A1 tanks. The TDA provided information on current inventory and TRADOC's DCSRM Equipment Division provided the resourcing equation.[27] Finally, we need to determine the resource effects of eliminating two tanks on the support activities. In this case, we were able to reduce the inventory of hydraulic lifts and transfer this equipment to another location. However, relocating both the tanks and the hydraulic lift requires one-time transportation costs, which are listed in the last column of the balance sheet as one-time resource changes. There are no changes in recurring resources because these tanks and the lift will continue to operate at similar levels at their new locations.

Table 3.15

Equipment Balance Sheet

Activities/ Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change	O.T./Rec.
	School Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity		
Delivery						
• Computers		+25 units			+25 units	O.T./Rec.
• M1/M1A1 tanks	-2 tanks		+2 tanks			O.T.
Development						
Support						
• Hydraulic lift	-1 hydraulic lift		+1 hydraulic lift			O.T.

Facilities Resources

Facilities include ranges, maintenance facilities, administrative and classroom buildings, and support facilities. Support facilities can include mess halls, barracks, supply facilities, medical facilities, and Petroleum, Oil, and Lubricants (POL) storage facilities. In the context of a training change, a change in facilities refers to the addition, subtraction, or alteration of facilities or land that support the training. A change can be measured in terms of the number or size of the facility or as its dollar cost (if no other descriptive information is available).

Changes in facilities can affect recurring costs (for example, new facilities will incur additional maintenance costs), but the major effect is on nonrecurring costs. When large quantities of training equipment must be provided at a field unit, it is almost inevitable that nonrecurring costs will be involved. These costs would include the construction of new facilities or the refurbishing or improving of existing facilities, such as the learning centers located on most posts.

Table 3.16 is an example of a facilities balance sheet. In this example, the remodels of learning center classrooms are both one-time and recurring changes because there is the one-time

[27]We fully explain the resourcing equation for tanks in both Appendix A and Section 5 of this document.

construction plus higher recurring facilities maintenance. The surplus in family housing that results from changing the course from a PCS to a TDY assignment results in both a one-time and a recurring change in resources. The balance sheet notes that, in this case, family housing will be allowed to go vacant. Family housing is listed twice because maintenance resources while idle are different from maintenance resources while occupied. If the costs were the same, we could have listed the change on the same line entry. Just the opposite occurs in activating temporary housing that has been idle. The recurring costs of maintaining the facilities will be different, and there are one-time resources that must be expended to activate vacant temporary housing facilities.

Table 3.16

Facilities Balance Sheet

Activities/ Resources	Targeted Organizations		Other Organizations	Excess Capacity	Net Change	O.T./Rec.
	School Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity		
Delivery						
• Classroom remodels		+10,000 sq. ft.			+10,000 sq. ft.	O.T./Rec.
Development						
	School Decrease	School Increase				
Support (housing in sq. ft.)						
• Occupied family housing	-340,000				-340,000	O.T./Rec.
• Idle family housing				+340,000	+340,000	Rec.
• Idle temporary housing				-100,000	-100,000	Rec.
• Activated temporary housing		+100,000			+100,000	O.T./Rec.

Once we have identified all the resource changes for each alternative, we summarize them and the type of change they represent—one-time and/or recurring. We then calculate the costs for these alternatives.

COST ANALYSIS

Table 3.17 is the general format for the summary of cost changes and accumulates the entries in the balance sheets we have presented up to this point.

Table 3.17

Catalogue of Cost-Causing Changes

Type of Change	Basis for Estimate of Cost or Savings	Type of Cost: Nonrecurring	Type of Cost: Recurring
DELIVERY			
Installation course length	-120 hours	X	X
Field unit course length	+40 hours	X	X
Student load reductions	-30 man-years		X
School annual ICH changes	-1173.6 ICHs		X
Learning center ICH changes	+400 ICHs		X
DEVELOPMENT			
New Product Development			
• Computer-based products	+10 products	X	
• Video products	+1 product	X	
Development sustainment			
• Conference products	-10 products		X
• Computer-based products	+5 products		X
• Video products	+1 product		X
SUPPORT			
Maintenance	-100 M1A1 miles	X	X
Family housing	-200 officer family years		X
Temporary housing	+200 officer man-years		X
Transportation	-500 officer relocations		X
MANPOWER			
Civilians	-7 GS-11	X	X
Military Transfers			
• Officers	+3 O-2	X	
• Enlisted	+3 E-4	X	
EQUIPMENT/MATERIEL/SUPPLY			
New equipment	+25 computers	X	X
Equipment transfers	+ 2 M1/M1A1 tanks	X	
	+1 hydraulic lift	X	
FACILITIES			
New facilities	+100,000 sq. ft.	X	X
Existing facilities			
• Occupied family housing	-340,000 sq. ft.	X	X
• Idled family housing	+340,000 sq. ft.		X
• Idled temporary housing	-100,000 sq. ft.		X
• Activated temporary housing	+100,000 sq. ft.	X	X

NOTE: If the context is one of reduced military end-strength, we capture the recurring savings in military pay and allowances in our separate analysis of military manpower.

Catalogue of Cost-Causing Changes. The column "basis for estimate" comes from the net change column in the balance sheets. The source of whether the cost-causing change is one-time and/or recurring also comes from the resource balance sheets. There is one case where the increase column is important. For the one-time transition training product development we include the products in the increase column.

Catalogue of Changes in Military Manpower. We create a special summary for the changes in military manpower. We do this because changes in military manpower may or

may not result in a net change, and the keys to whether there are changes are both our assumptions about which of the three consequences may result from a reduction in military training spaces and the budget context. For example, if we assume there are end-strength reductions and that the military grades that are eliminated from the end-strength correspond to the spaces we have reduced by our alternative training strategy, the cost savings are higher than if we assume that the end-strength reductions are accomplished in the form of accessions.

Table 3.18 is our summary of military manpower changes for our hypothetical example. The military instructors and students are transferred to other organizations, and end-strength is reduced by the corresponding grades of these personnel. If end strength is not being reduced, then these instructors and students may be used to improve capability in other parts of the Army.

Table 3.18

Catalogue of Changes in Military Manpower

Type of Manpower	Transfer to Other Organizations	Potential End-Strength Reductions
Officer	+1 O-2	-1 O-2
Enlisted	+3 E-4	-3 E-4
Students	+30 O-2	-30 O-2

Cost Determination. To determine the costs of these changes we use the general equation:

$$\text{cost} = \text{cost factor} \times \text{resource change}$$

The cost and resource factors for the equations are summarized in Appendix A.

We use a general cost template that is built on the premise that the resource implications of any given change will determine the cost of that change. The columns of the template are the resource changes and include the amount and type of resource change. The column entitled "activity levels" refers to specific changes in equipment utilization rates and facility utilization rates. The rows of the template are the cost elements.

Table 3.19 is the cost template we use for developing the specific cost models for the training alternatives. To illustrate how the template is used, first we examine the first row under nonrecurring costs. This is civilian personnel costs, and under this category are acquisition, initial training, separation, and transfer. An "X" appears under manning amount because this factor is used in the resourcing equation. An "X" also appears under manning type because there are grade distinctions among civilian personnel that dictate very different costs.

The template serves as a planning tool and checklist to ensure that important cost and resource factors are considered in the analysis. The template also serves an important function in the actual calculation of costs. It tells the analyst what factors need to be a part of the cost calculation. We have filled in some of the cells of the template to illustrate how the analyst would develop the specific cost equations for the example we have been using.

Table 3.19

Cost Template

Costs	Resource Factors						
		Manning		Equipment		Facilities	
	Activity Level	Amount	Type	Amount	Type	Amount	Type
NONRECURRING COSTS							
Civilian personnel cost							
• Acquisition							
• Initial training							
• Separation		X	X				
• Transfer							
Military personnel cost							
• Initial training							
• Transfer		X	X				
New training products		X	X				
Equipment procurement				X	X		
Equipment transfer				X	X		
Initial spares/stock							
Construction remodels						X	X
RECURRING COSTS							
Civilian personnel cost							
• Replacement acquisition							
• Replacement training							
• Pay and allowances		X	X				
Military personnel cost							
• Replacement training							
• Student PCS		X	X				
• Student TDY		X	X				
• Instructor TDY							
Training product maintenance		X	X				
Fuel, oil, etc. (POL)	X				X		
Replenishment spares							
Ammunition							
Equipment maintenance	X			X	X		
Product distribution							
Product reproduction							
Facility maintenance						X	X

Once we have calculated the costs for the various alternatives, we need to put them in a context that is meaningful to the decision maker. This involves identifying both qualitative and quantitative costs of the change.

PRESENTATION OF COSTS IN CONTEXT

To effectively place the costs in context, the decision maker needs to recognize several things. First, TRAM can be used to screen a large number of alternatives or to provide a detailed analysis of a favored few options; the decision maker needs to know which of these objectives is the purpose of the analysis. Second, the decision maker needs cost comparisons of the alternatives, and the cost comparisons for screening alternatives may be different from a de-

tailed analysis of the favored few options. The reason they are likely to differ is that a simple break-even analysis can probably suffice for screening, because we are trying to decide which of the many alternatives warrant further analysis. But more detailed cost and savings flow information or net present value calculations are warranted when we are focusing on a few favored alternatives.

It is also important to size the savings or costs in relation to a meaningful benchmark. Important tradeoffs—both qualitative and quantitative—and their attendant risks also need to be highlighted. Finally, the decision maker needs to know if other important findings surfaced during the analysis. We next discuss how TRAM places costs and savings in context by using cost comparisons, sizing of the costs or savings, and highlighting the tradeoffs, risks, and attendant issues.

Cost Comparisons

The first aspect of presenting costs in context to the decision maker is to develop cost and savings profiles for each of the alternatives. If we are screening a large number of alternatives, we can summarize the recurring and nonrecurring costs in the format illustrated in Table 3.20.

Table 3.20

Summary of Recurring and Nonrecurring Costs of Alternatives

	Alternative #1	Alternative #2	Alternative #3
Recurring Costs			
• Manpower			
• Equipment			
• Facilities			
Nonrecurring Costs			
• Manpower			
• Equipment			
• Facilities			
Break Even			

If we simplify the screening process by assuming that all nonrecurring costs occur in the first year and that recurring costs continue indefinitely into the future, we can use a simple approach to determine when the alternatives break even by dividing nonrecurring costs by recurring costs. This break-even analysis will show when the alternatives assume a favorable position. Depending on when the alternatives break even, some may not be reasonable in terms of equipment or skill obsolescence. For example, if the break-even point for developing a teletraining system is 10 years in the future, a different alternative with a shorter break-even point may be preferred because teletraining equipment purchased now might be obsolete in three years.

However, if our example has nonrecurring costs in future years, or if we are conducting a detailed analysis of a favored few options, we need to develop a cost profile of the alternatives. The source of the cost profiles is the individual cost model for each alternative. This cost profile shows when the costs and savings are incurred on a year-by-year basis. Table 3.21 is an

example of a cost profile for two alternative POIs. We sum the costs and savings to show that, even though two alternatives have the same costs and savings, the timing of the costs and savings may make a difference to the decision maker.

Table 3.21

Cost Profile: POI Alternative #1

	Savings/Cost Flows	
Year	Savings	Costs
FY 92		$100,000
FY 93		$50,000
FY 94	$120,000	$10,000
FY 95	$60,000	$10,000
FY 96	$50,000	$10,000
Total	$230,000	$180,000

Cost Profile: POI Alternative #2

	Savings/Cost Flows	
Year	Savings	Costs
FY 92		$100,000
FY 93	$70,000	$20,000
FY 94	$80,000	$20,000
FY 95	$50,000	$20,000
FY 96	$30,000	$20,000
Total	$230,000	$180,000

Figure 3.3 shows the alternatives' constant dollar flows over time.[28] In the case of these two options, the ultimate savings and costs are identical, but the time impact of costs for the two alternatives differs significantly. Alternative #1 requires higher initial transition costs prior to any flow of savings. However, the savings for Alternative #1 are greater in the latter years.

When developing time-phased cost profiles, inflation should be considered for each future year. Current dollars represent necessary inflation adjustments for future years.[29] A presentation of current dollars that parallels the constant dollar flow is necessary for budget projections.

In evaluating alternatives, we also need to determine when an alternative actually assumes a favorable position. In Figure 3.3, Alternative #2 assumes a favorable position prior to Alternative #1. We need to determine whether the alternatives are achieving favorable returns

[28]Constant dollars reflect the general purchasing power of the dollar at the time of the decision. Constant dollars allow for a direct comparison of activity levels from year to year prior to the introduction of inflationary cost factors.

[29]The Department of Defense publishes inflation indices annually. These indices include rates for all major appropriations, and we use these rates for the conversion to current dollars.

in a time frame that is reasonable in terms of equipment or doctrinal obsolescence and uncertainty.

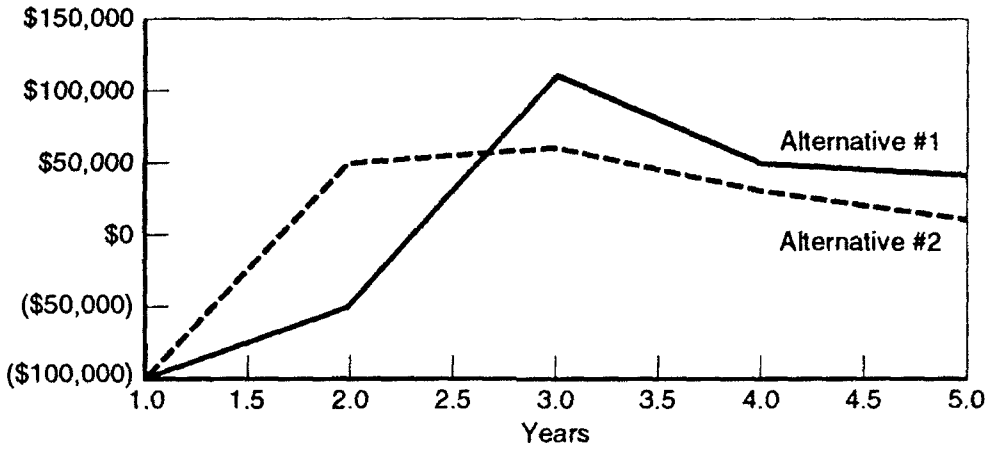


Figure 3.3—Constant Dollar Flows of Alternative POIs

In the face of uncertainty, we may have made some assumptions that strongly influence the costs of the alternatives. We may want to provide the decision maker with a range or band of costs surrounding the alternatives. Figure 3.4 is an example where uncertainty in the savings creates an overlap between the two alternatives in later years. Two things will generate uncertainty. First, there is a certain amount of statistical uncertainty. But the major source of uncertainty is in our assumptions. The ranges around the alternatives may reflect the effects of different assumptions.

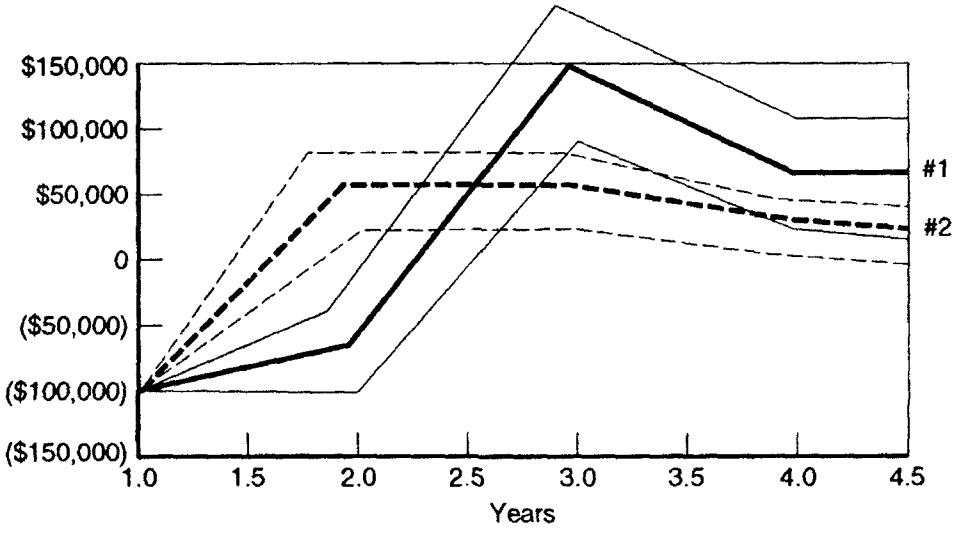


Figure 3.4—Ranges of Costs

We may also want to present net present values of projects to the decision maker in order to account for the time value of the investments.[30] Table 3.22 illustrates cost profiles with an attendant net present value calculation using a 10 percent discount rate.[31] Depending on the uncertainty surrounding the cost estimates, we may even want to develop net present values for the ranges we have established for the alternatives.

Table 3.22

Discounted Cost Profile: POI Alternative #1

Year	Savings/Cost Flows		Discount Factor	Net Present Value	Net Present Value
	Savings	Costs	10%	Savings	Costs
FY 92		$100,000	.0000		$100,000
FY 93		$50,000	.9091		$45,455
FY 94	$120,000	$10,000	.8264	$99,168	$8,264
FY 95	$60,000	$10,000	.7513	$45,078	$7,513
FY 96	$50,000	$10,000	.6830	$34,150	$6,830
Total	$230,000	$180,000		$178,396	$168,062

Discounted Cost Profile: POI Alternative #2

Year	Savings/Cost Flows		Discount Factor	Net Present Value	Net Present Value
	Savings	Costs	10%	Savings	Costs
FY 92		$100,000	.0000		$100,000
FY 93	$70,000	$20,000	.9091	$63,637	$18,182
FY 94	$80,000	$20,000	.8264	$66,112	$16,528
FY 95	$50,000	$20,000	.7513	$37,565	$15,026
FY 96	$30,000	$20,000	.6830	$20,490	$13,660
Total	$230,000	$180,000		$187,804	$163,396

Sizing of the Savings or Costs

We want to provide the decision maker with a meaningful benchmark as to whether these are large or small costs or savings. Depending on the training alternative, we need to identify meaningful benchmarks. In some cases, we might present the results in terms of a percentage of the current budget for the school. In other cases, perhaps the right benchmark is the current budgeted amount for a series of courses, the mission, or the affected training departments (e.g., First Armor Training Brigade or the Command and Staff Department).

[30]Present value is the amount represented by discounting a stream of costs and savings using a compound interest. The calculation of net present value is a calculation of the net savings or costs that takes explicit account of the timing of the costs and savings.

[31]We use a 10 percent discount factor because this is the rate required by the Army Cost and Economic Analysis Center (CEAC).

Tradeoffs

There are two levels of tradeoffs and risks that may concern various decision makers. The first is the detailed level and includes information on specifically which organizations are affected and what is being traded for the savings. This level of tradeoff analysis is important to decision makers associated with the affected organizations. The second level is the broader or more general consequences of the changes to the Army.

Detailed Level. One major benefit of TRAM is that it identifies the specific changes that result from changing the POI. As a result, we can provide the decision maker with information about how the course has changed (new, different, or eliminated content). We can also tell the decision maker which organizations are assuming additional training responsibilities and the potential general effect on those organizations. The catalogue of cost-causing changes is a good summary to point to the major activity and resource changes that result from the alternative POIs. This summary identifies changes in manpower, equipment, and facility utilization and transfer of activities to other organizations.

At the detailed level of tradeoffs, we highlight the effects of the changes on manpower, equipment, and facilities. We examine not only the savings and costs, but also the more-difficult-to-quantify aspects of morale, safety, and potential attrition. Figure 3.5 illustrates how we generally link the resource changes with more qualitative issues. In our illustration, soldiers will be training in their units. If the expectation is that they train in their off-duty hours, this may result in lower morale or greater attrition. Lower morale and higher attrition are difficult to quantify in this context, but are potential qualitative risks.

At the Army level, decision makers are concerned with the overall cost effects and the potential changes in readiness, capability, training effectiveness, and inflexibility or reversability of the alternatives. Inflexibility or built-in limitations of an alternative must be considered in the analysis. A design or program that does not allow for the possibility of change must be assessed more negatively than an alternative that does allow change.

TRAM does not quantitatively measure the effects on capability, readiness, training effectiveness, or reversability, but it does point to these issues in placing the costs in context for Army-level decision makers. These decision makers need to know if there are opportunities for using the changes in resources to improve capability of other parts of the Army or to meet required end-strength or budget reductions, and they need to know the potential risks and consequences in doing this. Our applications of the training resource analysis method outlined in the next two sections further illustrate different ways of placing the results in context for the decision maker.

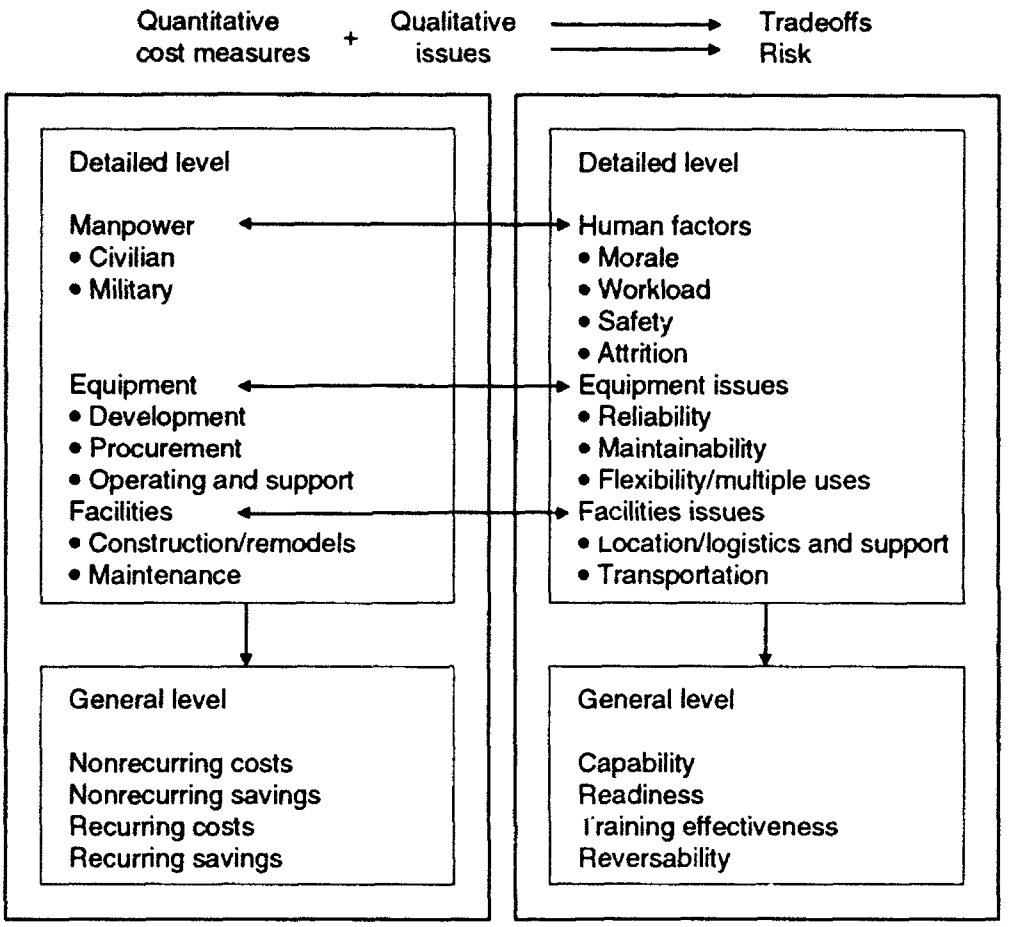


Figure 3.5—Balancing the Results

4. AN OFFICER APPLICATION OF THE METHOD: ARMOR OFFICER ADVANCED COURSE

In this section, we demonstrate the application of TRAM for costing alternatives using an officer course, the Armor Officer Advanced Course (AOAC). This course is the professional development course for armor senior first lieutenants and junior captains, and it qualifies graduates to assume company command or to function as assistant operations officers at the battalion or brigade staff level. The course is conducted at the U.S. Armor Center at Fort Knox, Kentucky.

The AOAC course was selected as a case study because TRADOC has identified this course as suitable for its distributed training strategy. TRADOC's distributed training strategy packages instruction so that it may be made available to troops and units in geographically dispersed locations through two major distribution mechanisms—electronic and mail delivery. These mechanisms encompass instructional systems such as computer-based instruction, videotape, and teletraining.

The application of TRAM to the AOAC produced three major findings. First, savings are possible if some lessons can be eliminated and the course shortened. Second, distributing training to the home units of course participants can produce savings. However, the magnitude of these savings is contingent on which media are used and how the training at the officers' home units is implemented. An important consideration is the capacity of the units and their ability to assume this additional training. Finally, the degree to which a course is shortened and distributed is constrained by the course's output objectives. Fundamental changes in the expectations for graduates of the AOAC course are required if the course is to be further reduced or distributed.

In applying TRAM to the AOAC, we demonstrate how to approach each of the five steps of the method. We consider four major alternatives that were generated by the RAND job analysis method we described earlier.[1]

DEFINITION AND SPECIFICATION OF THE CHANGE

We limit our analysis of the AOAC course in two important ways in order to concentrate on a full description of TRAM and its five key steps. First, we use a static approach to identify activity, resource, and cost changes. We divide the time horizon into two basic parts—the up-front transition phase (FY 92) and the recurring phase (post-FY 92 years). The second way that we limit this analysis is by considering only Active Component effects.[2]

[1]In addition to these four alternatives, we examined an alternative strategy that used teletraining. Teletraining was not viable because of its extremely high implementation costs. The alternative that we analyzed (one of TRADOC's proposed strategies) cost more than the present course. We include the cost results for this alternative in Appendix B.

[2]We do not include the Reserve Component in this analysis because there are many more constraints associated with these units. These constraints include limited training time, facilities, and equipment. TRAM can be used to

The Current Course Baseline

The document that supplies much of the necessary information for defining the baseline is the Program of Instruction (POI) that is in effect for FY 92.[3] The POI designates a minimum class size of 110 students, an optimal class size of 118 students, and a maximum class size of 122 students. For FY 92, the Army Program for Individual Training (ARPRINT) forecasts a total of 413 students attending the course.[4] The POI's designation of an optimal class size of 118 students and an input of 413 students means there will be four iterations of the class during FY 92. The POI notes there is currently no pre-course preparation required, and the focus of the course is tactical training—both offensive and defensive combined arms operations.

The total length of the course is 20 weeks, and students are in residence at Fort Knox for the duration. The 20-week length qualifies the course as a Permanent Change of Station (PCS) assignment, which means the officer and his family relocate to Fort Knox for the duration of the training.

Within the 20 weeks, 19.2 weeks (768 hours) are designated as academic or instructional hours. The remaining time is for student processing and diagnostic testing. Table 4.1 shows the distribution of the AOAC's 768 academic hours for the school's training departments. The course manager is assigned to the Command and Staff Department, which conducts 85 percent of the training.[5]

Table 4.1

AOAC Department Instruction

Training Department	Academic Hours	Percent of Total
Deputy Assistant Commandant (DAC)	6	1%
Command and Staff: General Instruction (C&S)	72	9%
Command and Staff: Small Group Instruction (SGI)	585	76%
Maintenance (Maintenance)	48	7%
Weapons	57	7%
Total	768	100%

The training departments' choices of instructional methods (e.g., conference, demonstration, practical exercises) are critical decisions because these methods eventually drive manpower,

assess alternative training strategies for the Reserve Component. However, the analyst must be very knowledgeable about the Reserve Component and its training organization.

[3]For this analysis, we used the April 1990 AOAC POI (U.S. Army Armor School, *Program of Instruction, Armor Officer Advanced Course,* Fort Knox, Ky., April 1990). There have been some changes to the course since this POI was approved, and we have attempted to incorporate as many of these changes as possible. However, this 1990 version was the most recent complete POI.

[4]The Army Training Requirements and Resources System (ATRRS) is the automated information system that provides input to training management information for the schools and training centers. The ARPRINT provides officer and enlisted training requirements, objectives, and programs for the Army.

[5]This includes general instruction (9 percent) and small group instruction (76 percent).

equipment, and facilities requirements.[6] Table 4.2 summarizes the methods of instruction by academic hour for each of the training departments for the AOAC course. Practical exercises are the dominant method used in the course and represent over 54 percent of all academic hours.

Table 4.2

Summary of Current AOAC Instructional Methods by Academic Hours for Each Training Department

Method of Instruction	DAC Hours	Maintenance Hours	Weapons Hours	C&S Hours	Total Hours
Conference	6.0	15.4	20.0	178.3	219.7
CBT	0.0	23.0	0.0	28.0	51.0
Demo	0.0	3.2	3.0	5.2	11.4
Practical exercises	0.0	2.0	32.0	387.1	421.1
TV/Seminar	0.0	0.4	0.0	2.4	2.8
Exams	0.0	4.0	2.0	56.0	62.0
Total	6.0	48.0	57.0	657.0	768.0

NOTE: These are the academic hours for one iteration of the course.

Proposed Alternatives to the Current AOAC Course

We consider four basic alternatives to the present AOAC course. However, for each one of these alternatives, we consider a best-case (low-cost) and a worst-case (high-cost) scenario. In addition, we use two different types of media for one of our alternatives. Table 4.3 summarizes the ten training options we consider in this application of TRAM.

Table 4.3

AOAC Course Options

			Alternative Media		
Alternative	"Best-Case" (Low-Cost)	"Worst-Case" (High-Cost)	"Best-Case" (Low-Cost)	"Worst-Case" (High-Cost)	Total
Trimmed course	X	X			2
Distributed	X	X	X	X	4
Change in mission	X	X			2
Small group transformation	X	X			2
Total	4	4	1	1	10

Trimmed Course. The first of our four basic alternatives, the "trimmed" course, is a simple elimination of 40 academic hours (one week) of the existing course. By reducing course length to 19 weeks, the course is transformed to a TDY assignment. This means that students are not relocated, but rather are on temporary duty while they attend the course. This fundamental change from PCS (relocation) to TDY (temporary duty) has important activity and resource effects that we highlight later in our analysis.

[6]See Table 3.1 for a full definition of the instructional methods and recommended instructor-to-student ratios.

Table 4.4 summarizes the learning events that are eliminated in this alternative. The elimination of these events does not necessarily result in capability losses because the students attending this course have had previous extensive training in these areas.[7] The Weapons Department is the major training department affected by this option.

Table 4.4

Events Eliminated in the Trimmed Course Alternative

Department	Event Eliminated	Hours Reduced
Weapons	Conduct of Fire Sustainment Training	20
Weapons	Boresight and Armament Accuracy	6
Weapons	Anti-Armor Weapons	4
Command and Staff	Army Writing Program*	10

NOTE: The Army Writing Program is transformed from an in-class exercise to a resident homework assignment.

Distributed Course. This option includes the 40 eliminated hours from the "trimmed" option and a transfer of 152 academic hours to the soldiers' home units. The remaining school academic hours total 576. Table 4.5 shows how these remaining 576 hours are now distributed among the school's training departments.

Table 4.5

Summary of Distributed Training Alternative Methods by Academic Hours for the School Training Departments

Method of Instruction	DAC Hours	Maintenance Hours	Weapons Hours	C&S Hours	Total Hours
Conference	5.0	8.0	3.0	119.8	135.8
CBT	0.0	23.0	0.0	25.0	48.0
Demo	0.0	1.0	0.0	5.2	6.2
Practical exercises	0.0	0.0	0.0	330.6	330.6
TV/Seminar	0.0	0.0	0.0	1.4	1.4
Exams	0.0	0.0	0.0	54.0	54.0
Total	5.0	32.0	3.0	536.0	576.0

The length of the resident course is reduced from the original 20 weeks to 15.2 weeks. The 152 distributed academic hours are now prerequisite study hours that each soldier completes in his unit or its associated learning center prior to course attendance. In this AOAC case, the units and their associated learning centers now responsible for this training are 69 worldwide active armor battalions.[8] In distributing these hours to the battalions, we employ two different media approaches. The first approach uses three different media types—computers,

[7]The rationale for eliminating these events is detailed extensively in a forthcoming RAND document that outlines the job analysis conducted for the AOAC course.

[8]This figure includes ACR Squadrons, Cavalry Squadrons, Light Armor Battalions, and TDA (Tables of Distribution Allowance) units. These figures reflect the Active Armor Branch for FY 92. (Source: Directorate of Total Armor Force Readiness, interview with author, January 1992.)

video, and paper—for the training. Table 4.6 summarizes the specific hours reduced for the school's training departments and the media used to distribute the training to the battalions. Of the 152 academic hours distributed to the units and their learning centers, 66 hours will be presented using printed materials, 16 hours will use videotapes, and 70 hours will use computer-based instruction.

Table 4.6

Distributed Course Alternative—Media Alternative #1

Department	Resident Academic Hours Subtracted	Academic Hours Added to Units by Media Type		
		Paper	Videotape	Computer
Deputy Assistant Commandant	-1	+1		
Weapons	-54 (30 hours eliminated*)	+2	+1	+21
Maintenance	-16			+16
Command & Staff	-121 (10 hours eliminated*)	+63	+15	+33
Total	-192	+66	+16	+70

NOTE: *The academic hours that are eliminated are the same hours eliminated in the "trimmed" alternative and represent previously trained subjects that the job analysis found could be eliminated from the current POI.

The second media approach we use to distribute this training is 100 percent paper-based instruction. The alternative is the same as presented in Table 4.6, but instead of three media types, we use printed material to train all 152 distributed hours.

Change in Mission. This alternative incorporates the changes included in the distributed course. However, an additional 15 hours of brigade-level instruction conducted by the Command and Staff (C&S) Department is eliminated. The elimination of these hours challenges one of the fundamental missions of the course—familiarization with brigade officer duties. The current AOAC course objectives are to expose graduates to a full range of armor missions and this alternative eliminates one of those missions. However, the elimination of this training does not necessarily result in a reduction in capability, because the student will not be applying this brigade-level training until several years in the future when he is a brigade commander.

The elimination of these additional hours of brigade-level instruction reduces the course length to 14.8 weeks. Table 4.7 summarizes the distribution of academic hours among the training departments for this alternative. Additional information concerning this alternative is included in Appendix B.

Table 4.7

Summary of Change in Missions Alternative Methods by Academic Hours for the School Training Departments

Method of Instruction	DAC Hours	Maintenance Hours	Weapons Hours	C&S Hours	Total Hours
Conference	5.0	8.0	3.0	114.3	130.3
CBT	0.0	23.0	0.0	25.0	48.0
Demo	0.0	1.0	0.0	5.2	6.2
Practical exercises	0.0	0.0	0.0	321.1	321.1
TV/Seminar	0.0	0.0	0.0	1.4	1.4
Exams	0.0	0.0	0.0	54.0	54.0
Total	5.0	32.0	3.0	521.0	561.0

Transformation of Small Group Instruction. This alternative also builds on the distributed option. The same 40 hours of instruction are eliminated, and the same 152 hours of training are distributed to the 69 armor battalions. However, the difference is that the remaining small group instruction conducted by the Command and Staff Department is transformed to large group instruction. Small group instruction for the AOAC course typically requires one instructor for every 10 students. Large group instruction for the course typically requires two instructors for every 110 students. By converting this small group instruction to large group instruction, there is a significant decrease in the overall number of instructors for the Command and Staff Department.[9]

Knowing the changes in instruction and academic hours is not sufficient to specify these alternatives fully. We also need to know how they will be implemented. However, there are a number of uncertainties involved, and we need to make some important assumptions in order to proceed with the analysis.

Assumptions

We need to be very clear about our assumptions and make them explicit so that the decision maker understands the extent and limits of our analysis. We have already mentioned two important assumptions in our description of the alternatives. First, we are assuming that a static analysis will suffice for screening these alternatives. Second, we are limiting our analysis to the Active Armor Component.

For this AOAC example, we organize our remaining assumptions by using two different scenarios concerning the implementation of our alternatives. These scenarios are a best-case (low-cost) scenario and a worst-case (high-cost) scenario.

Best-Case (Low-Cost) Scenario. Table 4.8 lists the assumptions associated with the "best-case" or low-cost scenario.

[9]Additional discussion and information concerning this alternative is included in Appendix B.

Table 4.8

Best-Case (Low-Cost) Assumptions

Training Activity	Location	Assumption
Delivery	Field learning centers	No additional instructional manpower
	Field learning centers	Off-duty course preparation
	Field learning centers	No additional training equipment
	Field learning centers	No additional facilities
	Field learning centers	No facilities modifications
Development	School	Estimated time values for media development
Support	Field learning centers	5% incremental maintenance on existing training equipment
	School	Temporary quarters available/No meals

In our set of low-cost assumptions for delivery activities, we make five key assumptions. First, we assume the training in the field units will be conducted at the learning centers that are located on post. These learning centers are TDA organizations and are under the supervision of TRADOC. These learning centers have the same basic workload factors as TRADOC. We assume that no additional instructors are required in the learning centers and that students will be required to train during off-duty hours. We assume that because students are training during off-duty hours they can utilize existing computer and video equipment. And we assume there are no additional facilities or facilities modifications required.

For the training development activity in our low-cost scenario, we use TRADOC's estimated time values for media development.[10] We assume that these current time values which estimate the man-hours by training product are accurate predictors of the manpower required to develop and sustain the new training products.

In the support activity area for our low-cost scenario, we also make several important assumptions. We assume that minimal additional maintenance will be required for computer and video equipment.[11] We also assume that because the course is changing from a PCS to a TDY assignment, the school has the capacity to handle this additional temporary housing load. However, we do know that the current food facilities at Fort Knox cannot handle this additional load, so we must provide the students with food allowances. Finally, we assume that the course's students are "TDY enroute" to their next assignment, and they do not have to be replaced in their units.

Worst-Case (High-Cost) Scenario. A key difference between the low-cost scenario and the high-cost scenario is the ability of the units and the school to absorb the changes in training activities without a significant attendant increase in resources and costs. Our high-cost scenario postulates that the units and their learning centers do need additional resources in or-

[10]These time values were developed in the 1980s and may not accurately reflect current development requirements. These standards are currently being revised. However, these values are what the Army now uses to resource training development, and we use them to serve as a benchmark for establishing a lower boundary on training development costs.

[11]The 5 percent factor we use was derived from discussions with the Command and Staff Department at Fort Knox. This department uses this type of equipment regularly, and it tracks maintenance requirements for incremental use.

der to conduct this training. Table 4.9 lists the assumptions for our worst-case or high-cost scenario.

Table 4.9

Worst-Case (High-Cost) Assumptions

Training Activity	Location	Assumption
Delivery	Field learning centers	Additional instructional manpower
	Field learning centers	On-duty course preparation
	Field learning centers	Additional training equipment
	Field learning centers	Facilities remodeled
Development	School	High dollar flat rate for media
Support	Field learning centers	25% incremental maintenance on new training equipment
	Field learning centers	Increased facilities maintenance
	School	No temporary quarters available/No meals

In the set of high-cost assumptions for the delivery activity area, we make four important assumptions.[12] We assume there is no excess resource capacity in the learning centers to absorb the additional training and that instructors will have to be added. However, instructors will be required for only the computer-based portions of the training. We also assume that training will take place during on-duty hours and that additional computer and video equipment will be required. The training facilities will also have to be remodeled in order to accommodate the additional students, instructors, and equipment.

For development, we use a different factor to determine the requirements for new training products and their sustainment. TRADOC's current estimated time values assume a static time period to develop a particular type of product. For example, to develop a computer-based training product requires 49 developer man-days. That one product may be one hour or five hours in duration, yet the man-days development requirement remains the same. In our high-cost scenario, we dissect development products into hourly increments and assign a flat dollar rate per hour for each type of product.[13] For example, a one-hour class costs $7,000 dollars to develop and a two-hour class costs $14,000 to develop. In the high-cost scenario, we track each new product by hour rather than simply by product.

For training support, we make two important assumptions. We assume that learning centers will be faced with additional maintenance for the new equipment and the new facilities.[14] And we assume that the school does not have the facilities to house the additional students. As a result, temporary housing and meals will be provided by commercial establishments, and students will be given the full TDY allowance for Fort Knox.

[12]We also assume under this high-cost set of assumptions that the learning centers will be responsible for the training.

[13]To develop these rates, we conducted a simple survey of various training development firms; our flat rates represent the median values we collected. Appendix A describes these rates and the survey in greater detail.

[14]For the maintenance of new equipment, we use TRADOC's standard factor of 25 percent of the value of the equipment to represent continuing maintenance.

Importance of These Assumptions

TRAM examines the effects of training changes in the context of the entire Army, not just TRADOC and its schools. Distributing additional training to soldiers' units and learning centers may require additional resource expenditures, depending on the existing capacity of the unit and/or learning center. The capacity for units to assume the additional training is a critical assumption. While there may be *some* resource "slack" in *some* units that would enable *some* degree of distributed training to be implemented at a fairly low cost, there is a point where this "slack" is exhausted and significant investments need to be made in order to distribute additional training. The break-point for excess capacity at the units illustrated by the vertical dotted line in Figure 4.1 is not known. To capture the consequences of this capacity issue, we needed to examine both sides of the vertical line pictured in Figure 4.1. This is why our assumptions are in the form of best-case and worst-case scenarios.

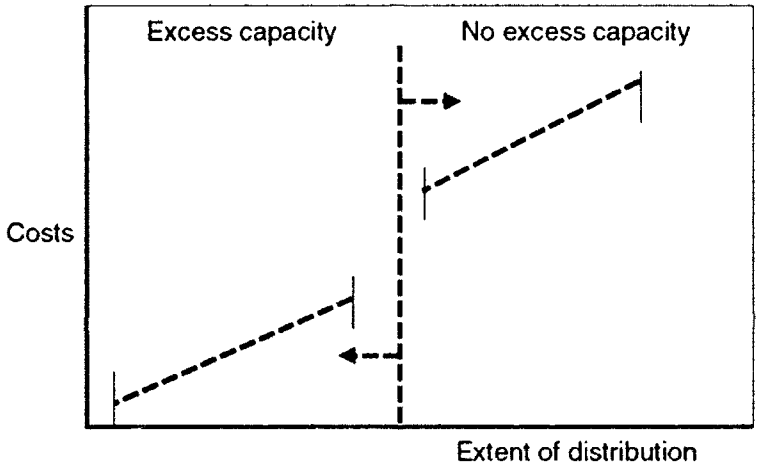


Figure 4.1—Capacity and the Costs of Distribution

Once the baseline and alternatives are defined and the key assumptions are explicit, the next step is to examine how these changes affect the activities of the course at the school and learning centers and their impact on other organizations—those indirectly affected by the change.

ACTIVITY ANALYSIS

In this illustration of the activity analysis step, we first analyze the current school functions that produce the AOAC course. We then show how an alternative can change the activities and how units and learning centers are affected. At this stage, we introduce the balance sheet that traces the activity changes. We focus on the distributed training option in our discussion of the activity analysis step and all the remaining steps of the training resource analysis method. This alternative incorporates the majority of changes included in the other alternatives (Appendix B includes additional information about the remaining alternatives).

Identifying Organizations Involved in the Current Course

The first step in the activity analysis is to segregate the current AOAC school functions into the major activity areas—delivery, development, and support. These are the principal functions of the school, and by segregating the various contributions of many functions to the course, we can better organize the analysis. That is, we can trace activities based on how they support the course. In addition, if the decision maker is interested, this process can highlight potential redundancies in activities and point to areas where there may be more efficient use of resources. Figure 4.2 lists the major AOAC-related Armor School activities. There are other functions and activities at the Armor School; however, we have limited our list to the functions that may directly or indirectly be affected by changes in the current AOAC course. The figure illustrates how we have categorized these functions.

Current AOAC Delivery Functions. The training departments are responsible for conducting the AOAC course, counseling students, reviewing instructional material, and grading exams and homework. Most delivery activities are driven by workload factors of student input, class size, and instructor contact hours (ICHs). There are a total of 8,259.8 ICHs for one iteration of the current AOAC course.[15] This figure is important because it is a key part of the formula for determining the total number of instructors that are currently resourced for this course. Table 4.10 shows the current distribution of ICHs among the training departments. Practical exercises represent almost 70 percent of all instructor contact hours.

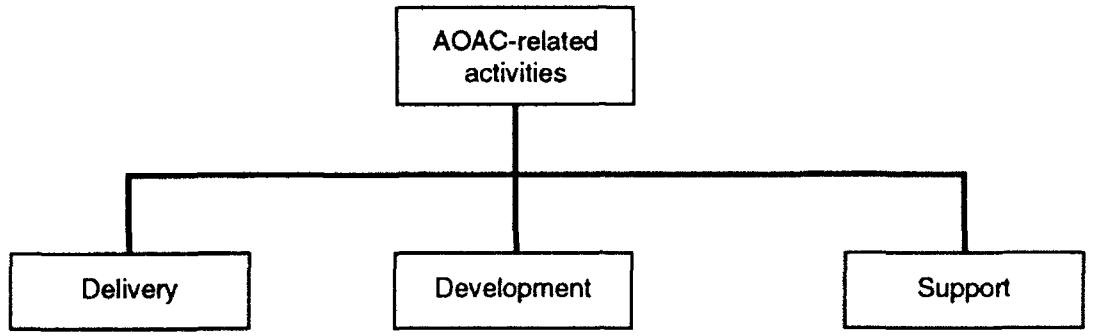
Table 4.10

Departmental Instructional Methods and Instructor Contact Hour Summary for Current AOAC Course

Method of Instruction	DAC ICHs	Maintenance ICHs	Weapons ICHs	C&S ICHs	Total ICHs
Conference	7.0	30.8	80.0	1,420.6	1,538.4
CBT	0.0	156.0	0.0	280.0	436.0
Demo	0.0	25.6	12.0	26.4	64.0
Practical exercises	0.0	112.0	1,840.0	3,720.8	5,672.8
TV/Seminar	0.0	0.8	0.0	3.8	4.6
Exams	0.0	8.0	8.0	528.0	544.0
Total	7.0	333.2	1,940.0	5,979.6	8,259.8

NOTE: These are the ICHs for *one* course iteration. For FY 92 there will be four course iterations, so each cell must be multiplied by four to arrive at the annual ICHs required during FY 92.

[15]These are not presently approved ICHs but represent the integration of the course's changes and the application of the TRAS requirements for the appropriate number of ICHs.



Training departments
- Conduct training
- Review instruction
- Support unit training

Training departments
- Write and design lessons
- Develop tests

Directorate of Training and Doctrine
- Manage AOAC SAT
 - —evaluate
 - —analyze
 - —design
 - —develop
 - —implement
- Manage AOAC TRAS
 - —Revise course documents
 - —Update instruction
 - —Review resource requirements
- Develop courseware
- Develop scripts
- Develop training support material
- Develop, evaluate simulations

Training departments
- Administer and manage training
- Maintain equipment

Directorate of Training and Doctrine
- Publish training material
- Train AOAC instructors
- Manage learning center

Directorate of Evaluation
- Evaluate training

Directorate of Plans, Training, and Mobilization
- Manage mobilization
- Schedule course
- Schedule equipment, ranges
- Coordinate ammunition

Directorate of Logistics
- Maintain major equipment
- Relocate students
- Procure and manage supply inventory

Directorate of Engineering
- Construct facilities
- Maintain facilities

Directorate of Resource Management
- Oversee course requirements
- Validate ICHs

Directorate of Personnel
- Process students
- Maintain academic records

Figure 4.2—AOAC Activities

Current AOAC Development Functions. Both the training departments and the Directorate of Training and Doctrine (DOTD) are involved in training development. Instructors frequently serve as subject matter experts and are responsible for the developing and writing of instructional programs for the course. The role of DOTD is one of coordination and transformation. First the DOTD coordinates with the training departments on the design and development of the instruction for the AOAC course.[16] It also transforms the instructor input into finalized training documents, training products, and training aids, devices, simulators, and simulations.

The number of training products (e.g., computer-based instruction, videos, examinations) and the associated man-hours required to produce these products are important workload factors for DOTD. The current AOAC course has 124 different lessons. Within these lessons are different instructional methods that have different product requirements. A single AOAC training event may include one, two, or up to five different instructional methods, and each method has its own development products. Table 4.11 summarizes the number of instructional products by method for the current AOAC course.

Table 4.11

Instructional Products for the Current AOAC Course

Method	Number of Products
Conference	102
Computer-based instruction	7
Demonstration	4
Practical exercises	82
Television/Seminar	4
Exams	13

Within the DOTD are two divisions that play an important role in the AOAC course. The Course Development Division within the DOTD oversees the preparation of special courseware such as computer-based training or simulations and manages instructional updates based on feedback from field units and other evaluation mechanisms. The Individual Training Division works with the training departments in the design and development of training strategies and training support materials for the AOAC course. This division also designs and assembles soldier training publications.

Current AOAC Support Functions. As Figure 4.2 illustrates, there are a large number of organizations with support roles for the AOAC course. The training departments provide administrative, management, and maintenance functions.[17]

The DOTD also provides a number of support activities. The Publications Division prepares the copy for documents developed by the Individual Training Division. The Staff and Faculty

[16]The DOTD is responsible for managing and monitoring the *Systems Approach to Training* (SAT). SAT consists of five steps in developing training: evaluating, analyzing, designing, developing, and implementing training.

[17]There are several workload factors that determine the amount of support overhead that is assigned to these departments. The management structure is determined by the number of staff supervised. However, the fundamental workload factors are class length and instructional methods, because these are the factors that determine instructor contact hours which, in turn, determine the number of instructors assigned to the course.

Development Division conducts courses and develops the POI for training the AOAC instructors. The Staff and Faculty Development Division also manages and maintains the televideo facilities. The Simulation, Automation, and Technology Division is responsible for the coordination, development, and evaluation of training device requirements.

There are a number of other installation groups that support the AOAC course.[18] The Directorate of Plans, Training and Mobilization (DPTM) is responsible for the distribution and maintenance of training aids and devices and other critica' training support material. This directorate is also responsible for scheduling the AOAC course, for scheduling and maintenance of the ranges used in the course, and for coordinating ammunition use. The Directorate of Logistics (DOL) is responsible for the maintenance of office and tactical equipment and provision of supplies. DOL also manages the relocation of the AOAC students. The Directorate of Engineering and Housing (DEH) is responsible for the assignment and maintenance of housing for these students and the construction and maintenance of all buildings, classrooms, and maintenance facilities on the installation. The Directorate of Resource Management (DRM) oversees the budgets for the various directorates and determines resource requirements based on TRADOC and commandant guidance. In addition, this directorate validates the instructor contact hours for the course. The Directorate of Personnel (DPA) is responsible for student processing and maintaining academic records.

Identifying Organizations Affected by the Alternatives

The next step of the activity analysis examines which specific organizations may be affected by the alternatives. The early identification of potentially affected organizations ensures that these groups are included in the next phase of the activity analysis and that their attendant resources and costs are not omitted.

To identify affected organizations, we answer the series of questions listed in Table 3.3 in Section 3.[19] Answering these questions will be an iterative process. We may not know all the answers when we first try to identify the affected organizations, but the questions serve as a planning tool to tell us areas we need to investigate. In this AOAC example, we include the answers to the questions concerning the distributed alternative for both the high- and low-cost scenarios, and Table 4.12 highlights the "yes" answers for the low-cost distributed training option and the ramifications of those "yes" answers we need to consider in the analysis. As we proceed with our analysis, we may need to return to this list and modify our initial answers or we may need to modify or add to our list of assumptions. Appendix A provides some additional information about sources for the answers to these questions.

[18]Student load, among other workload factors, determines the level of these activities.

[19]Tables 4.12 and 4.13 highlight only the questions with affirmative responses. Refer to Table 3.3 in Section 3 for the complete question list.

Table 4.12

Identifying Organizations Involved in the Low-Cost Distributed Option

Questions with "Yes" Answers for the Low-Cost Distributed Option	Affected Groups and Resources
Other organizations are now responsible for the training.	
• Which ones?	Active Armor Battalions-Learning Centers
Resources are being transferred.	
• Which resources?	1. Family housing 2. Temporary housing
• Where are these coming from, and where are they going?	1. Family housing: Active to idled 2. Temporary housing: Idled to active 3. Instructors: Operating end-strength
Resources are being eliminated.	
• Which resources?	Manpower
• Which organizations are affected?	Training departments
New training products are being added.	
• Which other courses might use the products?	No other course will use products.
Old products are being eliminated.	
• Which other courses will be affected?	No other course will be affected.
These training changes affect missions of others.	
• Which missions are affected?	1. Family relocations 2. Housing
There are changes in maintenance activities.	
• What maintenance levels are affected?	1st-, 2nd-, and 3rd-level maintenance
Training changes affect overhead.	
• Where is overhead affected?	Training departments

Table 4.13 highlights the "yes" answers for the high-cost distributed training option. Table 4.13 is different from Table 4.12 in several ways. It shows the added manpower, equipment, and facilities and the organizations affected by these changes. It also notes the potential indirect effects of equipment maintenance for the learning centers.

Table 4.13

Identifying Organizations Involved in the High-Cost Distributed Option

Questions with "Yes" Answers for the High-Cost Distributed Option	Affected Groups and Resources
Other organizations are now responsible for the training.	
• Which ones?	Active Armor Battalions—Learning Centers
Resources are being transferred.	
• Which resources?	1. Family housing 2. Instructor manpower
• Where are these coming from, and where are they going?	1. Family housing: Active to idled
Resources are being added.	
• Which resources?	1. Manpower 2. Equipment 3. Temporary housing 4. Classrooms
• Where are these coming from and where are they going?	1. Manpower from other organizations 2. Equipment will be procured 3. Temporary housing is commercial 4. Added classrooms to learning center
Resources are being eliminated.	
• Which resources?	Manpower
• Which organizations or courses are affected?	Training departments
New training products are being added.	
• Which other courses might use the products?	No other courses affected
Old products are being eliminated.	
• Which other courses will be affected?	No other courses affected
These training changes affect missions of others.	
• Which missions are affected?	1. Family relocations 2. Housing
There are changes in maintenance activities.	
• What maintenance levels are affected?	Unit level
Training changes affect overhead.	
• Where is overhead affected?	1. Training departments 2. Learning centers

Once we have identified the affected organizations, we then examine how the activities of these organizations change and translate the changes in activities into changes in workload.

Translating Activity Changes into Changes in Workload Factors

For this phase of the analysis we examine the changes in activities for our low-cost option and then compare the results to the high-cost option.

Distributed Option Changes in Delivery Activities. The key "best-case" or low-cost assumption that affects delivery activities is the students' off-duty course preparation. Reducing the length of the course by eliminating 40 academic hours and requiring off-duty

preparation for the 152 distributed hours reduces student time (the TTHS allowance) and increases the operating end-strength.[20]

Table 4.14 summarizes the workload factor changes in delivery activities that result from the low-cost distributed training option. The hours reflected in the table are annual instructor contact hours (ICHs).[21] The table also notes the change in student man-years that results from the course length reduction. The balance sheet shows the annual reduction of the instructor contact hours in the school decrease column. The lack of entries in the learning centers increase column reflects the assumption that no instructors will be required in the units.

Table 4.14

Change in Delivery Activities' Workload Factors: Distributed Option Low-Cost Assumptions

Activities/ Resources	School Decrease	School Increase	Learning Centers Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Net Change
ACADEMIC HOURS	-192.0 hrs					192.0 hours
Instruction						
• Conference	-1,651.2 hours					1,651.2 hours
• CBT	-120.0 hours					-120.0 hours
• Demo	-118.4 hours					-118.4 hours
• Practical exercises	-9,671.2 hours					,671.2 hours
• TV/Seminar	-12.8 hours					-12.8 hours
• Exams	-80.0 hours					-80.0 hours
M1 training	-48.0 miles					-48.0 miles
M1/M1A1 training	-120.0 miles					-120.0 miles
M60A3 training	-160.0 miles					-160.0 miles
STUDENT LOAD	-39.0 man-years				+39.0 man-years	0.0

The reduction in instructor contact hours by method of instruction appears in the net change column. However, the departments are individually resourced according to their individual instructor contact hours, and it is important to know how the ICHs change for each department because the type of instructor (e.g., military or civilian) and grades differ by department. Table 4.15 summarizes the changes in annual ICHs for each training department.

[20]One way a training change may potentially affect military personnel is through the reduction in the length of a course. For the active Army, end-strength authorized by Congress is reduced by an allowance for trainees, transients, holdees, students (TTHS), and cadets. Some fraction of active end-strength is always in transit between assignments, in resident training, or otherwise not available for assignment to authorized positions. The TTHS account provides authorizations for personnel not presently in the operating strength. A course that is reduced in length can affect the number of authorizations allocated to the TTHS account. If the TTHS account is reduced by shortening the length of a course, there may be more available manpower to be assigned to active operating strength.

[21]Our previous tables listed the ICHs for one iteration of the course. The tables in the activity analysis section list annual ICHs.

Table 4.15

Reductions in Resident Training Department Instructor Contact Hours for Both Low- and High-Cost Assumptions for the Distributed Training Option

Method of Instruction	DAC ICHs	Maintenance ICHs	Weapons ICHs	C&S ICHs	Total ICHs
Conference	-4.0	-59.2	-272.0	-1,316.0	-1,651.2
CBT	0.0	0.0	0.0	-120.0	-120.0
Demo	0.0	-70.4	-48.0	0.0	-118.4
Practical exercises	0.0	-448.0	-7,360.0	-1,863.2	-9,671.2
TV/Seminar	0.0	-3.2	0.0	-9.6	-12.8
Exams	0.0	-32.0	32.0	-16.0	-80.0
Total	-4.0	-612.8	-7,712.0	-334.8	-11,653.6

Table 4.16 is the balance sheet for the changes in delivery activities when using the high-cost assumptions. The high-cost set of assumptions includes the requirement of additional instructor manpower at the units.[22] The balance sheet reflects the annual computer-based instruction ICHs that are now transferred to the learning centers at the units. The balance sheet also shows student load transferring to the units. Under the high-cost set of assumptions, the students are trained at the units during on-duty hours. As a result, unit strengths are increased by the students. However, there is a reduction of 40 hours of training, which translates into man-years that can be transferred to other organizations.

Distributed Changes in Development Activities. Activity levels for training development are currently determined by associating a specified number of man-days (estimated time values) to training products. The estimated time values for new products are different from time values for existing products. New product development represents a one-time cost, while sustainment activities are recurring. To represent this difference, we have differentiated these two different development activities in our analysis. The net change column in Table 4.17 shows the difference in the number f instructional products that need to be sustained. The increase column shows the number of new products that need to be developed.

[22]The actual manning increase is based on full-time equivalents. The ICHs generate a requirement of four additional unit instructors for all 69 locations.

Table 4.16

Changes in Delivery Activities' Workload Factors: High-Cost Assumptions for the Distributed Training Option

Activities/ Resources	School Decrease	School Increase	Learning Centers Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Net Change
ACADEMIC HOURS • School • Learning centers	-192.0 hours	+152.0 hours				-192.0 hours +152.0 hours
Instruction • Conference	-1,651.2 hours					-1,651.2 hours
• CBT –School –Learning centers	-120.0 hours			+4,830.0 hours*		-120.0 hours +4,830.0 hours
• Demo	-118.4 hours					-118.4 hours
• Practical exercises	-9,671.2 hours					-9,671.2 hours
• TV/Seminar	-12.8 hours					-12.8 hours
• Exams	-80.0 hours					-80.0 hours
M1 training	-48.0 miles					-48.0 miles
M1/M1A1 training	-120.0 miles					-120.0 miles
M60A3 training	-160.0 miles					-160.0 miles
STUDENT LOAD	-39.0 man-years			+31.0 man-years	+8.0 man-years	0

NOTE: *The unit ICHs were derived by multiplying 70 CBT academic hours by 69 battalions.

Table 4.17

Change in Development Activities' Workload Factors: Low-Cost Assumptions for the Distributed Training Option

Instructional Products	School Decrease	School Increase	Learning Centers Decrease	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Net Change
Conference products	-41					-41
CBT products	-2	+7				+5
Demo products	-1					-1
Practical exercises	-18					-18
TV/Seminar products	-1	+11				+10
Exam products	-2					-2
Printed products		+23				+23
POI revision	-1	+1				0
Instructor course POI	-1	+1				0
Total	-67	+43				-24

Our "worst-case" or high-cost assumptions simply apply a flat development rate to each hour of development based on the type of product that must be produced and sustained. Table 4.18 illustrates the changes in development workload for our high-cost assumptions and is different from Table 4.17 in that the workload measure is hours rather than products. The school decrease column reflects the reduction in development sustainment activities for products associated with each current instructional method. The school increase column reflects the new development requirements for the academic hours that are being distributed to the units. The net change column reflects the difference in sustainment activities.

Table 4.18

Change in Development Activities' Workload Factors: High-Cost Assumptions for the Distributed Training Option

Instructional Method Hours	School Decrease	School Increase	Learning Centers Decrease	Learning Centers Increase	Transfers from (-)/to (+) Other Organizations	Net Change
Conference hours	-83.9					-83.9
CBT hours	-3.0	+70.0				+67.0
Demo hours	-5.2					-5.2
Practical exercise hours	-90.5					-90.5
TV/Seminar hours	-1.4	+16.0				+14.6
Exam hours	-8.0					-8.0
Paper-based instruction		+66.0				+66.0
POI revision hours		+96.0				+96.0
Instructor course hours		+96.0				+96.0
Total hours	-192.0	+344.0				+152.0

Distributed Option Changes in Support Activities. There are a number of changes in support activities. Table 4.19 is the balance sheet that summarizes the support activity changes for the distributed training option using the low-cost assumptions. Training department management has fewer instructors to supervise as a result of fewer AOAC ICHs. There are new publications that need to be produced, but there is an overall decrease in training development publications. In addition, these training products need to be distributed to the appropriate students at the appropriate times. There is some minor increase in unit maintenance as a result of the increased use of existing computer and video equipment. The entries for the Directorate of Logistics (DOL) show there is a reduction of 413 student relocations as a result of the conversion of the course to a TDY assignment. The entries for the Directorate of Housing (DEH) show the decline in family housing and the increase in temporary housing.

Table 4.19

Change in Support Activities' Workload Factors: Low-Cost Assumptions for the Distributed Training Option

Support Activities	School Decrease	School Increase	Learning Centers Increase	Transfer from (-)/to (+) Excess Capacity	Net Change
TRAINING DEPARTMENTS					
Management	-11,653.6 ICHs				-11,653.6 ICHs
DOTD					
Publications	-67 products	+43 products			-24 products
Distribution		+30 products			+30 products
UNIT MAINTENANCE			298 hours		+298 hours
DOL					
PCS moves	-413 moves				-413 moves
Food service		+413 food allowances			+413 food allowances
DEH					
Family housing					
• Active	-165 family years				-165 family years
• Idled		+165 family years			+165 family years
Temporary housing					
• Idled				-165 student years	-165 student years
• Active		+165 student years			+165 student years

NOTE: Maintenance hours are for all 69 learning centers.

The high-cost assumptions alter the balance sheet for support activities in several ways, and Table 4.20 highlights these differences. Under these assumptions there is a requirement to manage the instructors assigned to the units, and these new instructors need to be trained. These instructors will be actively involved in 70 hours of CBT training and responsible for managing and administering the other distributed training. At a minimum, they will require 70 hours of CBT training simply to become familiar with the material. We extended this training by 10 hours to include other portions of the distributed training and administrative procedures. Learning center maintenance and construction activities are higher under our set of high-cost assumptions. In addition, the balance sheet shows the requirement for additional temporary housing facilities.

Table 4.20

Change in Support Activities' Workload Factors: High-Cost Assumptions for the Distributed Training Option

Support Activities	School Decrease	School Increase	Learning Centers Increase	Transfer from (-)/to (+) Excess Capacity	Net Change
TRAINING DEPARTMENTS					
Management	-11,653.6 ICHs				-11,653.6 ICHs
LEARNING CENTERS					
Management		+4,830 ICHs			+4,830 ICHs
DOTD					
Publications	-67 products	+43 products			-24 products
Distribution		+30 products			+30 products
New instructor training		+80 academic hours			+80 academic hours
Replacement training		+80 academic hours			+80 academic hours
UNIT MAINTENANCE					
Equipment maintenance			+1,500 hours		+1,500 hrs.
Remodels			+69 classrooms		+69 classrooms
Facilities maintenance			+34,000 hours		+34,000 hours
DOL					
PCS moves	-413 moves				-413 moves
Food service		+413 TDY food			+413 TDY food
DEH					
Family housing					
• Active	-165 family years				-165 family years
• Idled				+165 family years	+165 family years
Temporary housing		+49,943 TDY days			+49,943 TDY days

NOTE: Maintenance hours are for all 69 learning centers.

The activity analysis has served the major purpose of identifying affected organizations and their changes in workload for our "best-case" (low-cost) and "worst-case" (high-cost) scenarios. The resource analysis now uses these results and other sources of information to trace the resource changes.

RESOURCE ANALYSIS

The resource analysis step of the method produces the specific manpower, equipment/supplies/materiel, and facilities changes that result from implementing the alternative. To ensure that we capture all the resources changes, we catalogue the activity changes by

summarizing the activity balance sheets. We also make initial estimates as to whether these activity changes are one-time or recurring types of changes. Summarizing these activity changes serves another purpose. We can show the decision maker which activities are changing in the course and what is being traded for savings. Table 4.21 is the summary of activity changes for our low-cost distributed training option. Table 4.22 summarizes the activity and workload changes for our high-cost set of assumptions.

Table 4.21

Catalogue of Low-Cost Distributed Training Activity and Workload Changes

Activity/Workload Changes	Type of Activity	
	One-time/Transition?	Recurring?
DELIVERY		
Installation course length (-192 hours)		X
Student load reductions (-39 man-years)		X
School annual ICH change (-11,653.6 ICHs)		X
• DAC (-4.0 ICHs)		
• Maintenance (-612.8 ICHs)		
• Weapons (-7,712.0 ICHs)		
• C&S (-334.8 ICHs)		
Tank mileage		
• M1 (-48 miles)		X
• M1/M1A1 (-120 miles)		X
• M60A3 (-160 miles)		X
DEVELOPMENT		
New product development (+43 products)		
• Computer-based products (+7)	X	
• Videotaped products (+11)	X	
• Printed products (+23)	X	
• POI revision	X	
• New instructor course	X	
Development sustainment		
• Conference products (-41)		X
• Computer-based products (+5)		X
• Demo products (-1)		X
• Practical exercises (-18)		X
• Videotaped instructional products (+10)		X
• Exam products (-2)		X
• Printed products (+23)		X
Product distribution (+30 products)		X
SUPPORT		
Training management (-11,653.6 ICHs)		X
Training publications (+43 new/-24 old)	X	X
Relocations (-413 officer moves)		X
Family housing		
• Active/Occupied (-165 officer family years)	X	X
• Idled (+165 family years)		X
Temporary housing		
• Active/Occupied (+165 officer man-years)		X
• Idle (-165 officer man-years)	X	X
Food allowances (+413 officers)		X

Table 4.22

Catalogue of High-Cost Distributed Training Activity and Workload Changes

Activity/Workload Changes	Type of Activity: One-time/Transition?	Type of Activity: Recurring?
DELIVERY		
Installation course length (-192 hours)		X
Field unit course length (152 hours)		X
Student load reductions (-1 man-year)		X
School annual ICH change (-11,653.6 ICHs)		X
• DAC (-4.0 ICHs)		
• Maintenance (-612.8 ICHs)		
• Weapons (-7,712.0 ICHs)		
• C&S (-334.8 ICHs)		
Tank mileage		
• M1 (-48 miles)		X
• M1/M1A1 (-120 miles)		X
• M60A3 (-160 miles)		X
Learning center ICH changes (+4,830 ICHs)		X
DEVELOPMENT		
New product development (+344 hours)	X	
• Computer-based hours (+70)	X	
• Videotaped hours (+16)	X	
• Printed hours (+66)	X	
• POI revision	X	
• New instructor course	X	
Development sustainment		
• Conference hours (-83.9)		X
• Computer-based hours (+67)		X
• Demo hours (-5.2)		X
• Practical exercises hours (-90.5)		X
• Videotaped hours (+14.6)		X
• Exam hours (-8.0)		X
• Printed hours (+66)		X
Product distribution (+66 hours)		X
SUPPORT		
Training management (-11,653.6 ICHs)		X
Learning center management (+4,830 ICHs)		X
Training publications (+43 new/-24 old)	X	X
New instructor training (+80 academic hours)	X	X
Equipment maintenance (+1,500 hours)		X
Remodels (69 classrooms)	X	
Classroom maintenance (34,000 hours)		X
Relocations (-413 officer moves)		X
Family housing		
• Active/Occupied (-165 officer family years)	X	X
• Idled (+165 officer family years)		X
Temporary housing (+413 students)	X	X
Full TDY Allowances (+49,943 days)		X

This catalogue of activity changes will aid us in identifying the associated resource changes. We first identify the resource changes for manpower using our low-cost distributed training alternative. We will then catalogue the manpower resource changes for the high-cost assumptions. We proceed to describe the equipment and facilities changes for the distributed training option using both the high- and low- cost assumptions.

Manpower Changes

As we have already noted, there are special considerations for military manpower changes. Military manpower is a unique resource because the overall composition of the Army is governed by separately imposed end-strength limits. Changes in training do not necessarily translate into net changes in force structure. However, if end-strength is being decreased, then the excess manpower created by the training alternatives may be offered for potential reductions.

Accounting for Military Manpower: Static End-Strength. To address this unique aspect of military manpower, we account for military manpower changes separately. Table 4.23 is the balance sheet for changes in manpower generated by the low-cost distributed training alternative when end-strength is not being reduced. The manpower balance sheet shows reductions in military manpower as transfers to other organizations.

Table 4.23

Distributed Training Manpower Changes: Low-Cost Assumptions and No Reductions in End-Strength

Activities/Resources	School Decrease	School Increase	Transfers from (-)/to (+) Other Organizations	Net Change	O.T./ Rec.
TRAINING DEPARTMENTS					
C&S					
• Military: Officer O-3	-3		+3		O.T.
Weapons					
• Civilian: GS-7	-6			-6	O.T./Rec.
DOTD					
New product development					
• Civilian: GS-11 (temp)		+9 (temp)		+9 (temp)	O.T.
Sustainment					
• GS-9	-2			-2	O.T./Rec.
SUPPORT					
Training Management					
C&S					
• Military: Officer O-4	-1		+1		O.T.
Weapons					
• Civilian: GS-9	-1			-1	O.T./Rec.
GS-5	-2			-2	O.T./Rec.
STUDENTS	-39 man-years		+39 man-years	0	Rec.

Accounting for Military Manpower: Changes in End-Strength. In the current climate, end-strength is being reduced, and Table 4.24 illustrates how the balance sheet accounts for changes in climate when Congress mandates end-strength reductions. The net change column notes the potential for reducing the force as a result of the low-cost distributed training alternative. The last column designates whether the change is one-time or recurring. If end-strength is being reduced, the reduction in military manpower is both a one-time and a recurring action.

Table 4.24

Distributed Training Manpower Changes: Low-Cost Assumptions and Reductions in End-Strength

Activities/Resources	School Decrease	School Increase	Transfers from (-)/to (+) Other Organizations	Net Change	O.T./ Rec.
TRAINING DEPARTMENTS					
C&S					
• Military: Officer O-3	-3			-3	O.T./Rec.
Weapons					
• Civilian: GS-7	-6			-6	O.T./Rec.
DOTD					
New product development					
• Civilian: GS-11 (temp)		+9 (temp)		+9 (temp)	C.T.
Sustainment					
• GS-9	-2			-2	O.T./Rec.
SUPPORT					
Training management					
C&S					
• Military: Officer O-4	-1			-1	O.T./Rec.
Weapons					
• Civilian: GS-9	-1			-1	O.T./Rec.
GS-5	-2			-2	O.T./Rec.
STUDENTS	-39 man-years			-39 man-years	O.T./Rec.

Determining the Quantity and Type of Manpower Changes. To determine the actual quantity and type of manpower changes, we use the resourcing factors and other key information on manning. For the training departments, the change in manpower is determined by the change in ICHs, which we determined in the activity analysis step. Each department's manpower changes are listed separately, and the specific grade levels of the incumbents are also listed. We had to review each organization's TDAs in order to determine the ranks and civilian grade-level ratings of the individuals affected by the changes.

The change in DOTD (Directorate of Training and Doctrine) personnel for the low-cost option is determined by the estimated time values currently used to resource training developers.[23] Each product has a man-days factor, and we have totalled the man-days for each product to arrive at man-year figures for sustainment and new development. Since this new product

[23] *Workload Categories for Training Development Processes and Products*, January 26, 1987. The estimated values presented also include revisions made in FY 1990.

development is a one-time transition activity, we listed the additional civilian personnel as temporary. There would be no need to retain these individuals after the initial development has been completed. This entry in the balance sheet could also be a requirement for contractors rather than temporary employees. The present entry serves the same purpose.

We use the existing resourcing equations to determine the changes in training management that result from the reduction of instructors. For the Command and Staff Department, the reduction was one supervisor, and for the Weapons Department there was a reduction of two supervisory positions. Clerical support for the Weapons Department was also reduced as a result of fewer instructors and supervisors.

The high-cost assumptions for the distributed training option produce several differences in the manpower balance sheet, which are illustrated in Table 4.25. The balance sheet shows a reduction of 3 officer instructors at the school and an increase of 4 instructors at the units. The excess manpower at the school is transferred *to* other organizations. The increase in manpower for the units is designated by a transfer *from* other organizations, with a change of -1 officer instructor for other organizations. The requirement of instructors in the units also generates a need for supervision.

If we were accounting for military manpower during end-strength reductions, the military manpower entries in the transfer to other organizations column shown in Table 4.25 would appear in the net change column to reflect the opportunity for reducing military manpower spaces.

The other major difference in the high-cost balance sheet is the designated hours for product development and sustainment. In the low-cost manpower balance sheet, we reflected the development changes in man-years. However, in the high-cost balance sheet, we are reflecting these as changes in hours because we are using a flat hourly product rate to determine both development costs.

Equipment Changes

Table 4.26 shows the equipment changes generated by the low-cost distributed training alternative. The table shows a reduction in the number of Conduct of Fire Trainer (COFT) trainers. Instructor/Operator manning for the COFT is the largest resource required for operating these training devices. We captured this change in the resource analysis for manpower. The Weapons Department was reduced by 6 Instructor/Operators. Other operating expenses such as equipment maintenance would not likely be affected significantly by the AOAC reduction, because the excess capacity created by the elimination of AOAC COFT sustainment training will likely be used by other courses or other applications. The same is true with the turret trainer and the small group instruction computer equipment. That is why we have shown the reduction in the equipment associated with these devices as a transfer to excess capacity. There is also a reduction in ammunition use, which is reflected in the balance sheet. The DOTD also generates an equipment requirement with the addition of temporary development personnel. The balance sheet includes the distribution of materials and the reproduction requirements.

Table 4.25

Distributed Training Manpower Changes: High-Cost Assumptions

Activities/Resources	School Decrease	School Increase	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Net Change	O.T./ Rec.
TRAINING DEPARTMENTS						
C&S						
• Military: Officer O-3	-3			+3		O.T.
Units						
• Military: Officer O-3			+4	-4		O.T.
Weapons						
• Civilian: GS-7	-6				-6	O.T./Rec.
DOTD*						
SUPPORT						
Training Management						
C&S						
• Military: Officer O-4	-1			+1		O.T.
Units						
• Military: Officer O-4			+1	-1		O.T.
Weapons						
• Civilian: GS-9	-1				-1	O.T./Rec.
GS-5	-2				-2	O.T./Rec.
STUDENTS	-39 man-years		+31 man-years	+8 man-years	0	Rec.

NOTE: *Reflected in cost analysis as a flat dollar rate per hour of product development.

Table 4.26

Distributed Training Equipment Changes: Low-Cost Assumptions

Activities/ Resources	School Decrease	School Increase	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity	Net Change	O.T./ Rec.
TRAINING DEPARTMENTS							
Computers	-1				+1 unit		
Maintenance							
• COFT	-43				+43 units		
• Turret trainer	-1				+1 unit		
• Computers	-1				-1		
Units							
• Computers			+69		-69		
DOTD							
Computers	-2	+9			+2	+7	O.T.
SUPPORT							
Ammo	-69 rounds					-69 rounds	Rec.

Table 4.27 includes the equipment changes for the distributed training option using the high-cost assumptions. This set of assumptions postulated that there must be additional equipment purchased in order to distribute the training to the units. The balance sheet shows the computer equipment requirement and the backup (spares) in the learning centers increase column. The balance sheet listing for computers also includes cables, print monitors, and modems. The listing for televideo equipment includes cassettes, monitors, audio players, and recorders.

Table 4.27

Distributed Training Equipment Changes: High-Cost Assumptions

Activities/ Resources	School Decrease	School Increase	Learning Centers Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity	Net Change	O.T./ Rec.
TRAINING DEPARTMENTS							
School							
• Computers							
Unit	-1				+1		O.T.
• Computers							
• Unit spares			+69			+69	O.T.
• Televideo equipment			+69			+69	Rec.
			+69			+69	Rec.
SUPPORT							
Ammo/Simulation	-69 rounds					-69 rounds	Rec.

Facilities Changes

Table 4.28 is the balance sheet for the facilities changes for the low-cost distributed training option. There are several things to note about this balance sheet. First, our low-cost assumptions postulate that there is sufficient learning center capacity at the units to house the 413 AOAC students during their prerequisite study weeks. The balance sheet demonstrates this by subtracting the necessary facilities from excess capacity. However, there is a difference in maintenance requirements for idled and occupied facilities. The two separate entries for the classrooms alert us to this difference in facilities' maintenance. TRADOC uses a figure of 600 square feet for each classroom. We used this figure to determine the number of square feet required at the units ($69 \times 600 = 41{,}400$ square feet).

The family housing entry in the balance sheet shows the reduction in these facilities due to the transformation of this course from a PCS assignment to a TDY assignment. Family housing is listed twice in the balance sheet because the maintenance costs of these facilities will differ when they are idled—just as with the unit classrooms. Temporary housing is treated similarly. There is now a requirement for greater occupation of the school's existing temporary housing. This will increase the maintenance requirement for this form of housing.

Table 4.28

Distributed Training Facilities Changes: Low-Cost Assumptions

	School Decrease	School Increase	Learning Centers Increase	Transfer from (-)/to (+) Excess Capacity	Net Change	O.T./ Rec.
Learning centers (in sq. ft.)						
• Idled classrooms				-41,400	-41,400	O.T./Rec.
• Active classrooms			+41,400		+41,400	Rec.
Housing (in sq. ft.)						
Family housing						
• Occupied	-784,700				-784,700	O.T./Rec.
• Idled				+784,700	+784,700	Rec.
Temporary housing						
• Idled	-165,000				-165,000	O.T./Rec.
• Occupied		+165,000			+165,000	Rec.

The high-cost assumptions change the facilities balance sheet in several ways (see Table 4.29). First, there is now a construction requirement for the learning centers. Second, instead of using existing temporary housing on the post, the additional burden for temporary housing is assumed by commercial facilities. This entry alerts us to the increased TDY costs that will be associated with commercial establishment use.

Table 4.29

Distributed Training Facilities Changes: High-Cost Assumptions

	School Decrease	Units Increase	Transfer from (-)/to (+) Other Organizations	Transfer from (-)/to (+) Excess Capacity	Net Change	O.T./ Rec.
Learning centers Remodeling (in sq. ft.)		+41,400			+41,400	O.T./Rec.
Housing (in sq. ft.)						
Family housing						
• Occupied	-784,700				-784,700	O.T./Rec.
• Idled				+784,700	+784,700	Rec.
Temporary housing			+commercial		+commercial	Rec.

We needed to make some assumptions about how the distributed training option would be implemented. We used two scenarios—high- and low-cost—in order to span the potential range of implementations. We then used these assumptions in the activity analysis to determine which organizations may be affected by the distributed training alternative and how the delivery, development, and support functions for these organizations may change. The resource analysis delineated the specific resource changes. We now proceed to the final steps of TRAM—the cost analysis and placing the costs in context.

COST ANALYSIS AND COSTS IN CONTEXT

In this step we translate the net changes in activities and resources, as determined by the balance sheets, into net changes in costs. We will again use the multimedia distributed training alternative to demonstrate the detailed cost analysis phase of the method. However, we will include comparisons of the cost results for all the alternatives.[24]

Catalogue of Cost-Causing Changes

Table 4.30 lists the types of changes generated by the low-cost implementation of the distributed training alternative. The majority of entries under the "Basis for Estimate of Costs and Savings" column are from the "Net Change" column of the balance sheets. The resource numbers of this column form the basis of the calculation in net changes in cost. The right-hand columns of the table indicate which types of costs are potentially involved. The first type is the nonrecurring cost, which is required during the transition period. The second type is the annually recurring costs and savings once the change is implemented.

The "New Product Development" number does not come from the "Net Change" column in the activity analysis. It is the total from the "School Increase" column, and this reflects the transitional character of this activity.

The military manpower changes are also not included in this table. However, military transfers are listed. The reason is that although end-strength may not be affected by the change, these military will have to be transferred to other assignments, which will likely involve significant nonrecurring costs. The number of transfers in the "Basis for Estimate" column come from the manpower balance sheet and the column "Transfer from/to Other Organizations." We simply total the number of moves by rank and grade to and from other organizations to determine the number of military transfers.

[24]The details of the cost analysis of the other alternatives can be found in Appendix B.

Table 4.30

Distributed Training Option Catalogue of Cost-Causing Changes: Low-Cost Assumptions

Type of Change	Basis for Estimate of Cost or Savings	Type of Cost: Nonrecurring	Type of Cost: Recurring
ACTIVITIES			
School delivery	-11,653.6 ICHs (-39 load)		X
M1	-48 miles		X
M1A1	-120 miles		X
M60A3	-160 miles		X
New product development	+43 new products	X	
Development sustainment	-24 products		X
Training support			
• Training management	-11,653.6 ICHs		X
• Training publications	+413		
Distribution			
• PCS relocations	-413 relocations		X
Field computer maintenance	+1,445 hours		X
Field video maintenance	+330 hours		X
MANPOWER			
Civilians			
• GS-5	-2	X	X
• GS-7	-6	X	X
• GS-9	-3	X	X
• GS-11 temporary	+9	X	
Military transfers			
• Officer-3	+3	X	
• Officer-4	+1	X	
EQUIPMENT			
DOTD computer equipment	+7 computer units	X	X
Ammunition/missile simulation	-69 rounds		X
FACILITIES			
Idled classrooms	-41,400 sq. ft.	X	X
Occupied classrooms	+41,400 sq. ft.		X
Family housing: occupied	-784,700 sq. ft.	X	X
Family housing: idled	+784,700 sq. ft.		X
Temporary housing: idled	-165,000 sq. ft.	X	X
Temporary housing: occupied	+165,000 sq. ft.		X

Table 4.31 is the catalogue of cost-causing changes for the high-cost assumptions. There are several areas that are different. This balance sheet shows the transfer of ICHs to the units, which will result in an increase in instructor manpower at those locations. We also reflect the student status of the AOAC participants through the transfer of the 31 student man-years factor. We reflect the development activities as product hours rather than a total number of products as is listed in Table 4.30. The "New Product Development" hours come from the school increase column in the development activities balance sheet. This table also reflects the increased requirement of equipment and facilities for the units and the attendant increase in maintenance. In addition, replacement training for the new field instructors is part of the cost-causing changes. The final difference is in how we reflect the lack of temporary housing capacity at the school.

Table 4.31

Distributed Training Option Catalogue of Cost-Causing Changes: High-Cost Assumptions

Type of Change	Basis for Estimate of Cost or Savings	Type of Cost: Nonrecurring	Type of Cost: Recurring
ACTIVITIES			
School delivery	-11,653.6 ICHs (-39 load)		X
Learning center delivery	+4,[illegible]30 ICHs (+31 load)		X
M1	-48 miles		X
M1A1	-120 miles		X
M60A3	-160 miles		X
New product development	+43 new products	X	
Reproduction	+413 training manuals	X	X
Distribution	+413 mailings	X	X
Development sustainment	-24 products		X
School training support			
• Training management	-11,653.6 ICHs (-39 load)		X
Instructor training	+2 weeks/instructor		X
• Other (DEH, DOL, DRM)	-39 student load		X
Unit training support	+31 student load		X
PCS relocations	-413		X
MANPOWER			
Civilians			
• GS-5	-2	X	X
• GS-7	-6	X	X
• GS-9	-1	X	X
New training products	+344 product hours	X	X
Sustainment of products	-152 product hours		X
Military transfers			
• Officer-3	+7	X	
• Officer-4	+2	X	
Replacement training	+2 weeks annual turnover		X
EQUIPMENT			
Field computer equipment	+69 computer units	X	X
Field computer spares	+69 computer units	X	X
Televideo equipment	+69 units	X	X
Field computer maintenance	+138 units		X
Field video maintenance	+69 units		X
Ammunition/missile simulation	-69 rounds		X
FACILITIES			
Learning center construction	+41,400 sq. ft.	X	X
Family housing: occupied	-784,700 sq ft	X	X
Family housing: idled	+784,700 sq. ft.		X
Temporary housing	+commercial facilities		X

Cost Model

Cost results are derived from the resource and activity changes through the application of the cost template. TRAM provides a general cost template that can be tailored to fit a variety of training decision costing exercises. The cost template distinguishes between nonrecurring

and recurring costs. We use this general template as a checklist to determine which aspects of cost apply to our distributed training option. Table 4.32 lists our cost model for the distributed training option.

The X's under the various resource factors indicate that this resource factor is an element of the equation used to calculate the cost for our distributed training alternative. For example, in the low-cost model, we need to acquire temporary civilian developers. To determine the cost for this element, we multiply the number and type of developers we need by the acquisition cost factor for each developer. Under recurring costs for large equipment, an additional resource factor is added—activity rate. This factor refers to the operating activity (miles or hours) that is required by equipment.

Table 4.32

Distributed Training Cost Model: Low-Cost Assumptions

Cost Factors	Resource Factors						
		Manning		Equipment		Facilities	
	Activity Rate (miles or hours, etc.)	Amount	Type	Amount	Type	Amount	Type
NONRECURRING COSTS							
Civilian personnel cost							
• Acquisition		X	X				
• Initial training		X	X				
• Separation		X	X				
Military personnel cost							
• Transfers		X	X				
Equipment procurement				X	X		
Publications proofs				X	X		
Facility activation		X	X			X	X
Facility deactivation		X	X			X	X
RECURRING COSTS							
Civilian personnel cost							
• Pay and allowances		X	X				
Military personnel cost							
• Student PCS		X	X				
• Student TDY		X	X				
Fuel, oil, etc. (POL)	X			X	X		
Replenishment spares	X			X	X		
Ammunition	X			X	X		
Equipment maintenance				X	X		
Product distribution		X					
Product reproduction		X					
Facility maintenance						X	X

Table 4.33 is the cost model for the distributed training option using the high-cost assumptions. There are two additional cost elements included in this table that were not included in the low-cost model. One element is initial training for field instructors. The second element is replacement training for these instructors. However, the results of applying this cost model to the high-cost assumptions will produce significantly different results because the

basic resource factors are different. There are different manpower, equipment, and facilities requirements under the high-cost assumptions option.

Table 4.33

Distributed Training Cost Model: High-Cost Assumptions

Cost Factors	Resource Factors						
		Manning		Equipment		Facilities	
	Activity Rate (miles or hours, etc.)	Amount	Type	Amount	Type	Amount	Type
NONRECURRING COSTS							
Civilian personnel cost							
• Separation		X	X				
Military personnel cost							
• Transfers		X	X				
• Initial training		X	X				
Equipment procurement				X	X		
Initial spares				X	X		
Facility activation		X	X			X	X
Facility deactivation		X	X			X	X
RECURRING COSTS							
Civilian personnel cost							
• Pay and allowances		X	X				
Military personnel cost							
• Replacement training	X	X	X				
• Student PCS		X	X				
• Student TDY		X	X				
Fuel, oil, etc. (POL)	X			X	X		
Replenishment spares	X			X	X		
Ammunition	X			X	X		
Equipment maintenance				X	X		
Product distribution		X					
Product reproduction		X					
Facility maintenance						X	X

We use a spreadsheet application to apply the cost factors to the changes in resources. In this example, we simplify the analysis by assuming that all nonrecurring costs occur in FY 92 and that the recurring costs and savings begin in FY 93 and continue indefinitely into the future. Table 4.34 presents the cost results of the low-cost distributed training option. The first group of costs, nonrecurring costs, represents the one-time costs of distributing the training. The second group, recurring costs, includes both recurring costs and (in parentheses) recurring savings.

The major nonrecurring costs for this option are the acquisition of temporary training developers to design and produce the distributed material. However, that cost is roughly half the cost to deactivate family housing.

The recurring savings quickly compensate for the one-time costs involved in implementing this option—if we believe we can implement this change under the best-case conditions. The majority of the savings are principally personnel-related. The reduction in weapons instruc-

tors and training department overhead coupled with the transformation of the course from a PCS to a TDY assignment represent the greatest portion of the savings. Another significant recurring savings area is in the reduction of maintenance for family housing—if it is deactivated. However, there is the opportunity for additional savings for the installation if personnel were relocated on base. One way to detail this option is to create a subset of balance sheets that deal with this particular family housing issue.

Table 4.34

Results of Low-Cost Distributed Training Option

NONRECURRING COSTS	
Acquisition of temporary developers	$455,000
Initial training of new developers	$30,000
Separation costs of civilian personnel	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$35,000
Officer transfers	
• O-3	$27,000
• O-4	$10,000
DOTD computer equipment procurement	$22,000
Publications new proofs	$28,000
Family housing deactivated	$785,000
Temporary housing activated	$165,000
Unit classrooms activated	$41,000
Total costs	$1,670,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($117,000)
Student PCS	($3,421,000)
Student TDY	$2,241,000
DOTD computer maintenance	$6,000
Reproduction	$29,000
Distribution	$21,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Family housing maintenance reduction	($785,000)
Temporary housing maintenance increase	$495,000
Classrooms maintenance increase	$124,000
Total savings	($1,761,000)

Table 4.35 lists the specific cost changes for the high-cost distributed training alternative. The transition costs under this set of assumptions are significantly higher than for the low-cost option. The key elements that increase the transition costs are the development and construction costs. The savings are also significantly reduced as a result of the lack of capacity to house students on base and increased equipment maintenance.

Table 4.35

Results of High-Cost Distributed Training Option

NONRECURRING COSTS	
Civilian personnel costs	
Separations	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$12,000
Military personnel costs	
Initial training	$3,000
Transfers	
• O-3	$64,000
• O-4	$20,000
New training products	$1,942,000
Equipment procurement	
• Computers	$224,000
• Video recorders	$131,000
Facility deactivation	$785,000
Temporary housing activated	$165,000
Construction of classrooms	$3,728,000
Total costs	$7,370,000
RECURRING COSTS/(SAVINGS)	
Civilian pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($39,000)
Military personnel costs	
• Student PCS	($3,421,000)
• Student TDY	$3,340,000
• Replacement training	$1,000
Training product maintenance	$46,000
Reproduction	$29,000
Distribution	$21,000
Computer equipment maintenance	$112,000
Video recorder maintenance	$33,000
Ammunition	($95,000)
Weapons	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Learning center maintenance	$124,000
Family housing maintenance reduction	($785,000)
Total savings	($893,000)

Before we turn to comparing the cost results for all of the alternatives, we need to examine the outcomes of the options on military manpower. Table 4.36 compares the military manpower results for two sets of assumptions. By requiring students to take the prerequisite hours during off-duty time, there is the potential for reducing the number of authorizations assigned to the TTHS account. These authorizations may then be applied to operating end-strength. Although the students would not be assigned to the TTHS account while they are in the units, having them complete the prerequisite study during on-duty time does not allow

for the potential reduction in manpower. However, the important point is that we save almost 10 percent of the student manpower with the reduction in the course for the low-cost alternative. In a context of declining end-strength, the summary of military manpower would show that these spaces are available for contributing to the reduction in military manpower. That is, the summary would show a net change for the force.

Table 4.36

Military Manpower Results: Low- and High-Cost Assumptions

	Low-Cost Option		High-Cost Option	
	Transfers from/to other organizations		Transfers from/to other organizations	
Type of Manpower	From	To	From	To
Officer: O-3		3	4	3
Officer: O-4		1	1	1
Students		39		8
Total		43	5	2

Cost Results for All Options

For each of the alternatives, we used the activity analysis, the resource analysis, and the cost model to produce the specific cost results. Because the distributed training option included many aspects of the other options, the majority of effort was in the initial activity analysis phase. Tailoring the cost model to the other alternatives was not difficult.

Savings with No End-Strength Reductions. Figure 4.3 shows the recurring savings results for all alternatives using both low- and high-cost assumptions.[25] We also assume no reductions in end-strength.

The figure lists the savings in thousands of dollars. There is a large increase in savings when moving from the trimmed option (the elimination of one week) to the distributed training option. The trimmed course provides $654,530 in recurring savings, while the distributed training alternative yields almost triple that amount. The other alternatives add small increments of savings to the distributed training alternative, with the greatest savings occurring under the change in mission alternative.

The recurring savings decline dramatically if we employ our high-cost assumptions. The savings for all but the trimmed alternative are reduced by almost 50 percent. However, there is a very interesting trimmed course outcome in the recurring savings arena. This is the only instance where transforming the course from the PCS assignment to a TDY assignment actually costs more. This result hinges on the lack of capacity of the Armor School to provide quarters for the students.

The major reasons for the decline in savings under our high-cost assumptions for the other alternatives are the differences in temporary housing costs and maintenance—both for equipment and facilities. The relative rankings of savings also change under this set of as-

[25]The cost and savings results for the AOAC case study are presented in current dollars.

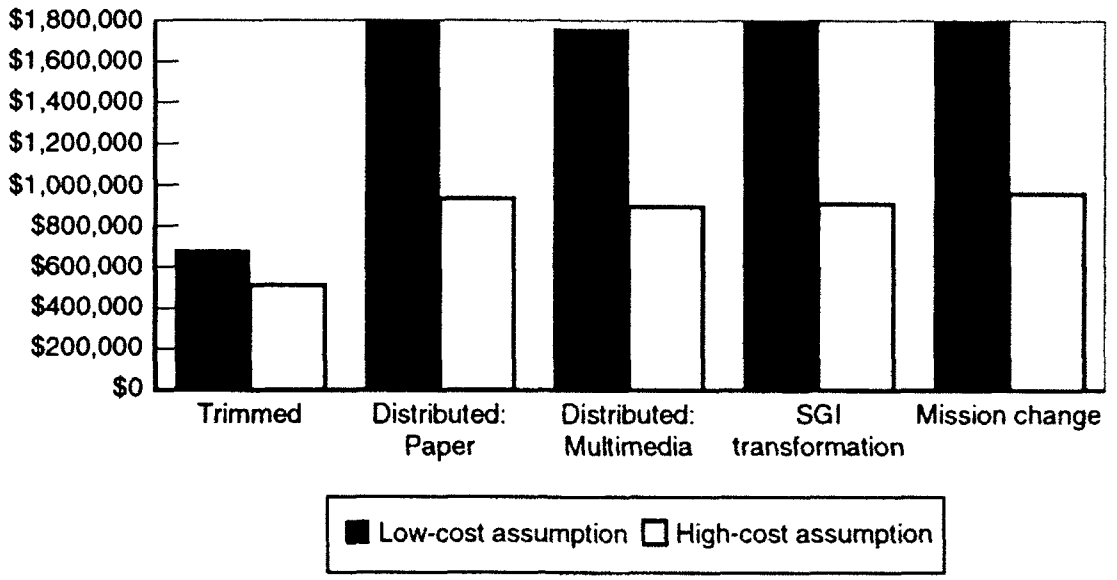


Figure 4.3—Recurring Savings: No Reduction in End-Strength

sumptions. The distributed option using one media—paper—produces greater savings than transforming the small group instruction. The major difference between these two is the development sustainment effort required. The paper alternative requires fewer sustainment hours as compared to sustaining the computer-based instruction and the video instruction.

Savings with End-Strength Reductions. The savings escalate dramatically when we include the recurring savings from reducing military manpower. Table 4.37 shows the changes in military manpower for all the alternatives—using both high- and low-cost assumptions. If we assume no end-strength reductions, then the personnel are transferred to other organizations. If the climate is one of end-strength reductions, then the summary highlights the potential for force reductions.

For these alternatives, there are two significant areas for changes in military manpower. First, under the low-cost assumptions, 39 student man-years may be reduced. Second, under both the high- and low-cost assumptions for transforming SGI, 14 Command and Staff instructors may be reduced.

Figure 4.4 illustrates that savings more than double when manpower is included. However, this doubling is contingent on eventual reduction of similar spaces that are listed in Table 4.37.

Costs with No End-Strength Reductions. The nonrecurring costs for both low- and high-cost assumptions are shown in Figure 4.5. The costs for all options under the low-cost assumptions are below $2,000,000. For all but the trimmed option, the major transition costs are in the areas of new development and changes in moving from family housing facilities to temporary housing facilities. Civilian separation costs and military transfers also play a role in these transition costs.

Table 4.37

Military Manpower Results: Low- and High-Cost Assumptions

Alternatives and Type of Manpower	Low-Cost Option		High-Cost Option	
	Transfers or net change		Transfers or net change	
	From	To	From	To
Trimmed Option				
Distributed Option				
• Officer: O-3		3	4	3
• Officer: O-4		1	1	1
• Students		39		8
Distributed Paper				
• Officer: O-3		3	4	3
• Officer: O-4		1	1	1
• Students		39		8
Change in Mission				
• Officer: O-3		3	4	3
• Officer: O-4		1	1	1
• Students		39		8
SGI Transformation				
• Officer: O-3		14	4	14
• Officer: O-4		2	1	2
• Students		39		8

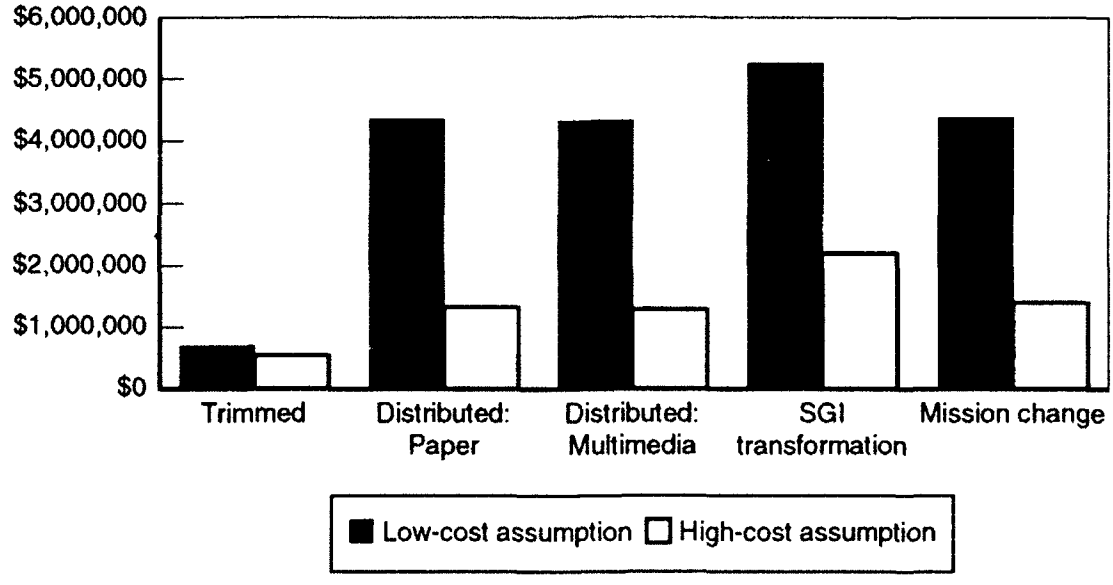


Figure 4.4—Recurring Savings: Reduction in End-Strength Assumption

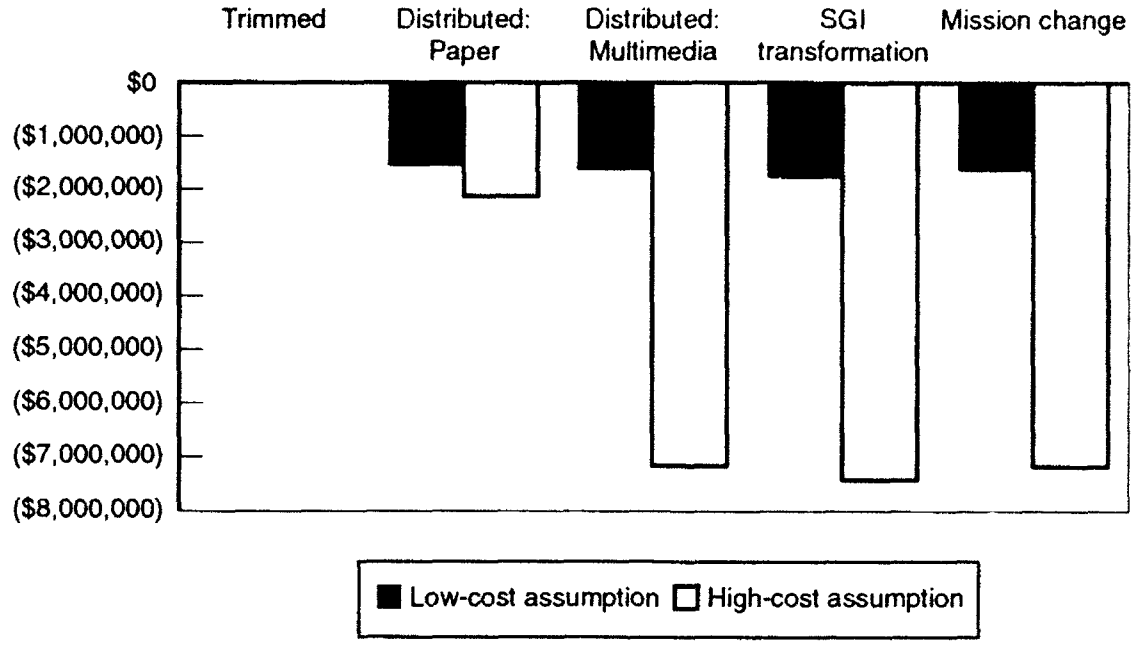


Figure 4.5—Nonrecurring Costs: No End-Strength Reductions

The cost story is very different if we use the high-cost assumptions. For the majority of alternatives, the costs triple. This is due principally to the increase in construction and equipment costs required by this set of assumptions. In addition, the higher development costs escalate these costs. The trimmed course transition costs differ from the low-cost results by a much lesser degree. This is due to the simple elimination of courses and events and no transfers of training to the soldiers' home units.

Costs with End-Strength Reductions. Figure 4.6 shows the results when we include the one-time costs associated with reducing military manpower. These military manpower costs include the separation pay and PCS moves for soldiers in the same grades as the spaces that were reduced by our training alternatives.

Costs in Context

Once the cost models have yielded their results, the final step is to place the costs in context for the decision maker. This requires comparing the alternatives, "sizing the costs and savings," identifying the tradeoffs, highlighting the limitations of the analysis, and identifying potentially larger issues that surface during the analysis.

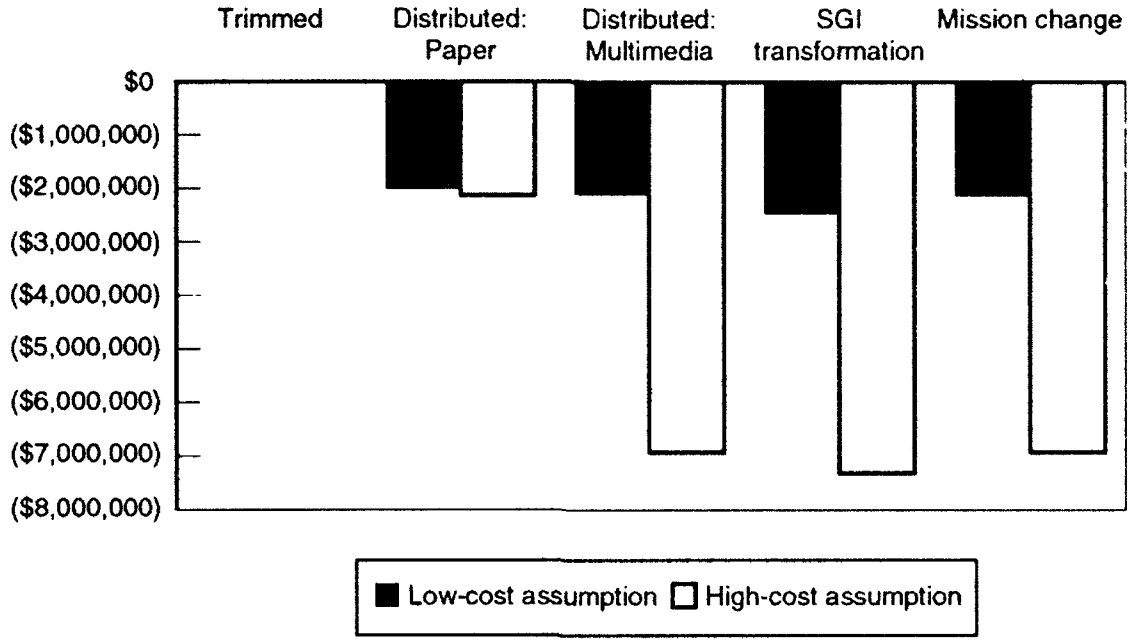


Figure 4.6—Nonrecurring Costs: With End-Strength Reductions

Comparisons of the Alternatives. First, we need to compare the alternatives. Table 4.38 lists the savings and costs for the alternatives using the low-cost assumptions. Table 4.39 shows the comparisons of the alternatives using the high-cost assumptions.

Table 4.38

Comparisons of Alternatives: Low-Cost Assumptions

Costs/Savings	Trimmed	Distributed: Paper	Distributed: Multimedia	SGI Transformation	Mission Change
RECURRING COSTS/(SAVINGS)					
Manpower	($1,041,000)	($1,580,000)	($1,541,000)	($1,580,000)	($1,580,000)
Equipment	($126,000)	($33,000)	($54,000)	($52,000)	($54,000)
Facilities	$495,000	($166,000)	($166,000)	($166,000)	($166,000)
Total	($672,000)	($1,779,000)	($1,761,000)	($1,798,000)	($1,800,000)
NONRECURRING COSTS					
Manpower	$77,000	$587,000	$629,000	$817,000	$641,000
Equipment	$1,000	$43,000	$50,000	$50,000	$50,000
Facilities	N/A	$950,000	$991,000	$991,000	$991,000
Total	$78,000	$1,580,000	$1,670,000	$1,858,000	$1,682,000

NOTE: Current dollars rounded to thousands.

Table 4.39

Comparisons of Alternatives: High-Cost Assumptions

Costs/Savings	Trimmed	Distributed: Paper	Distributed: Multimedia	SGI Transformation	Mission Change
RECURRING COSTS/(SAVINGS)					
Manpower	$464,000	($363,000)	($363,000)	($363,000)	($466,000)
Equipment	($190,000)	($33,000)	$131,000	$111,000	$159,000
Facilities	($785,000)	($537,000)	($661,000)	($661,000)	($661,000)
Total	($511,000)	($933,000)	($893,000)	($913,000)	($966,000)
NONRECURRING COSTS					
Manpower	$77,000	$171,000	$171,000	$255,000	$171,000
Equipment	$8,000	$1,064,000	$2,521,000	$2,686,000	$2,521,000
Facilities	N/A	$950,000	$4,513,000	$4,513,000	$4,513,000
Total	$85,000	$2,185,000	$7,205,000	$7,454,000	$7,205,000

NOTE: Current dollars rounded to thousands.

Figure 4.7 shows the various break-even points for both the high- and low-cost assumptions. Certainly, under either set of assumptions, the trimmed course is a viable first step. In analyzing individual training, it is important to understand thoroughly the basic course objectives and to eliminate those events and tasks that are tangential to the basic objectives. The distributed paper option under either set of assumptions also provides savings opportunities within a short period of time. The other alternatives, which use higher technology mixes, increase the costs of distribution and diminish savings. The degree to which the costs increase and the savings decrease depends on the assumptions and the actual implementations.

Figure 4.8 shows the break-even points when we use the assumption that there will be a reduction in end-strength. The time to recapture the costs of change is greatly reduced under both the low- and high-cost scenarios.

This analysis points to the importance of considering more than one alternative for changes in training and the context of the change. The training resource analysis method can screen many alternatives and detail costs for preferred implementation options.

Another important result of this analysis is the need to determine the degree of excess capacity in the units. The point where distribution exceeds the capacity of the units is the point where costs will escalate significantly and savings will diminish significantly. Distribution that exceeds the excess capacity of the units requires the establishment of unit training infrastructures that duplicate those at the schools.

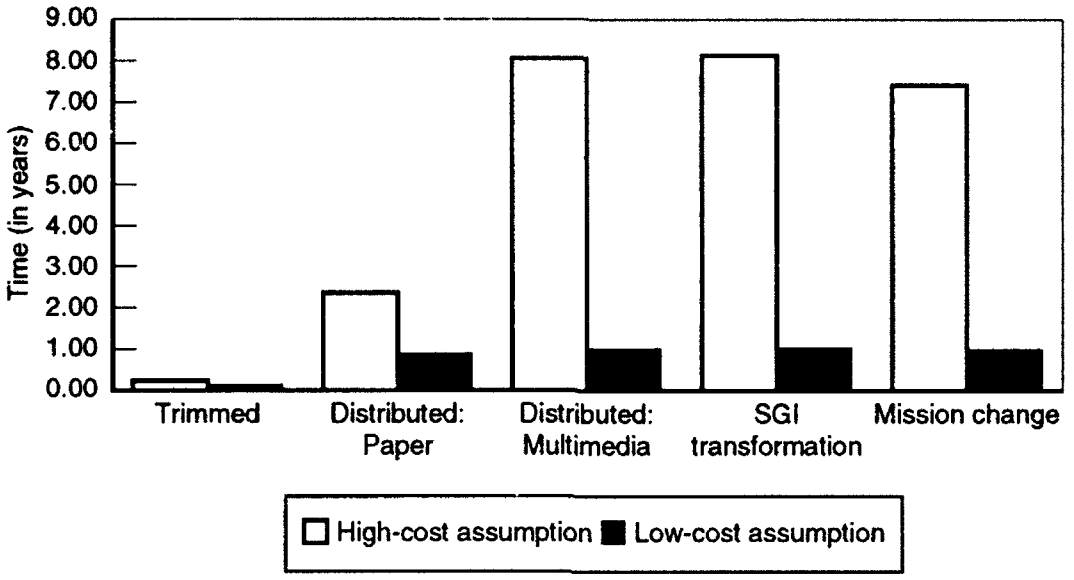


Figure 4.7—Break-Even Analysis of Options: No End-Strength Reductions

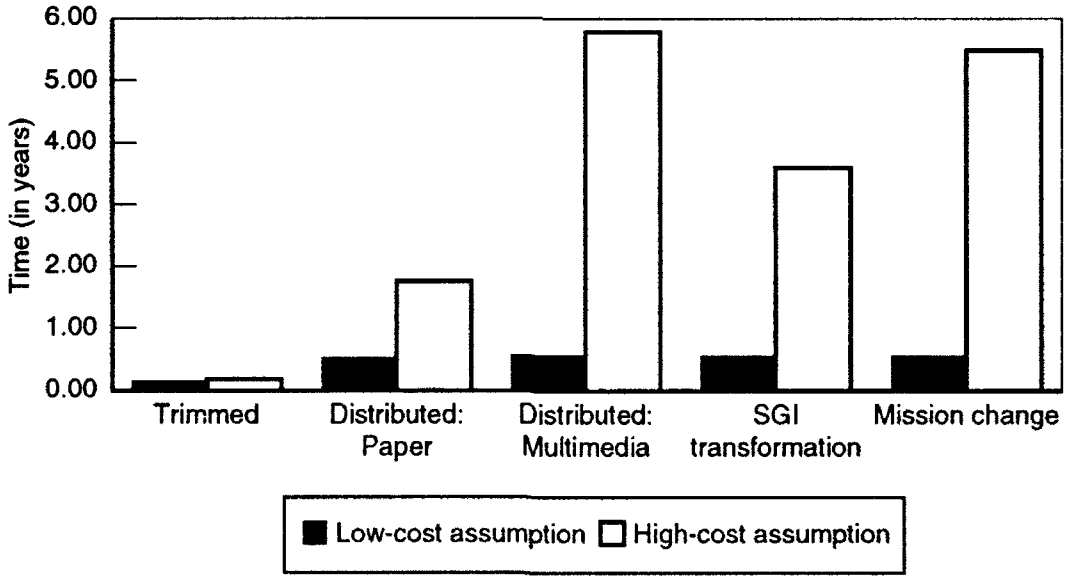


Figure 4.8—Break-Even Analysis of Options: End-Strength Reductions

Sizing the Costs and Savings. If we focus for a moment on the trimmed course and extrapolate its savings across the Armor School, this "scrubbing" of the courses offers respectable savings. Figure 4.9 shows the potential "slice of savings" for AOAC and what might be achieved by re-examining all Armor School courses.[26] The extrapolated savings represent the potential savings if all armor courses have the same level of potential savings as the AOAC course.[27]

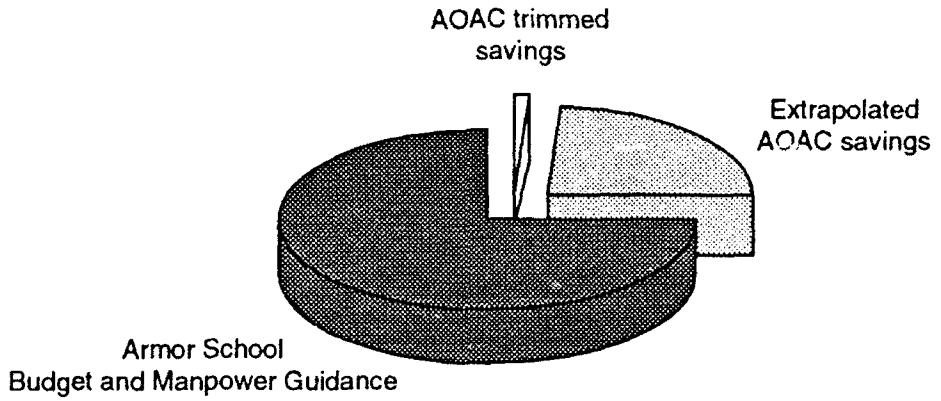


Figure 4.9—Sizing the Change

Tradeoffs. There are some important qualitative tradeoffs that need to be considered in the analysis. These include the the potential effects on proficiency for the units that result from changing the training and the morale effects of family separations and extended workdays.

Under our best-case or low-cost assumptions, we are requiring these soldiers to spend their off-duty time training. We are increasing the soldiers' workdays without any real compensating changes, and this requirement may have spillover effects on both morale and attrition. Also, under the best-case scenario, the extent of the training is reduced, and it is self-directed. The magnitude of the effects of these two factors on the soldiers' proficiency and the units' capability is not known. However, one fact remains: the units will be receiving less thoroughly trained officers.

In addition, under our best-case scenario, we are not adding any additional equipment or facilities. The potential costs for reversing the decision to distribute the AOAC training, if the effects on proficiency are sufficiently negative, are not as great as the worst-case scenario, where the Army is investing in both equipment and extended learning centers.

Under the worst-case scenario, we are anticipating that the soldiers are trained during on-duty hours. This has a less negative effect on morale because we are not increasing the

[26]We used the 1992 Armor Budget and Manpower Guidance as the baseline for determining the context of the potential savings.

[27]For certain courses, this extrapolation is relevant. As we will show in our next case study, there is little to be eliminated from the M1/M1A1 Armor Crewman Course. However, leader development courses, such as AOAC, seem to offer more opportunity for scrubbing courses down to the essentials.

workday, but there is a tradeoff in readiness and capability. These soldiers are not available for their regular assignment in the units, and they are still not as thoroughly trained at the end of the changed AOAC course.

Limitations of the Analysis. Our analysis did not address the Reserve Component. Distributing training can significantly affect this group because of their already limited training time and access to facilities and equipment. Finally, there are other student populations that need to be considered. These include the foreign students, the other branches that participate in the AOAC course, and the Cavalry. There are important considerations of when and how these groups will obtain their training.

The Bottom Line. In this case study, TRAM highlights the importance of the transition costs, which are often underestimated. It also considers the context of the change for the opportunities for reducing military manpower. It demonstrates that savings are indeed possible if some unnecessary lessons can be eliminated and the course shortened. Distributing training to the home units of course participants can produce substantial savings. However, the magnitude of these savings is contingent on which media are used and on the assumptions concerning how the training is implemented in the field. If the distributed training alternative proves to have adverse consequences on proficiency, the costs of reversing the alternative also depend on how it is implemented.

TRAM also concludes that a key factor in distributing training is the capacity of field locations to assume this additional training. Distributed training may help to reduce some costs of training. There eventually will be a point of diminishing returns from distributed training. At some point, significant investments will be required for an infrastructure to support distributed training. Finally, the degree to which a course is shortened and distributed is constrained by the course's output objectives and the overall importance of these objectives. Fundamental changes in expectations for graduates of the AOAC course are required in order to achieve further savings.

5. AN ENLISTED APPLICATION OF THE METHOD: M1/M1A1 ARMOR CREWMAN ONE STATION UNIT TRAINING COURSE

In this section, we demonstrate the application of the training resource analysis method using an enlisted course, the M1/M1A1 Armor Crewman (19K) One Station Unit Training (OSUT) Course. In this application, we use TRAM's detailed approach for analyzing a "favored alternative." This detailed approach is different from the AOAC approach in that we are analyzing one alternative in depth rather than trying to screen a number of alternatives, and we investigate the ramifications of this alternative over time. The principal reason we are examining the 19K OSUT course over time is because projected student input for the course is forecasted to fluctuate significantly over the next few years, and the costs and savings of changes vary with these fluctuations. Figure 5.1 illustrates the projected fluctuations in student input.

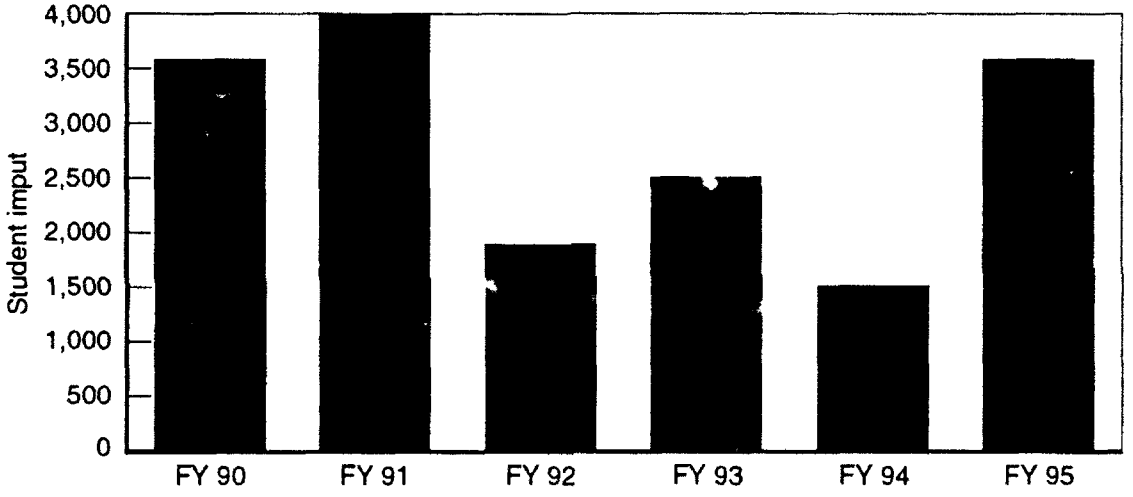


Figure 5.1—19K OSUT Student Input

DEFINITION AND SPECIFICATION OF THE CHANGE

Our analysis focuses on changes in savings and costs that result from implementing training strategies. The most important step in the analysis is to thoroughly define the current course and the proposed alternative.

The 19K OSUT course is conducted at the U.S. Armor Center at Fort Knox, Kentucky, and combines basic training and advanced individual training (AIT).[1] The AIT portion teaches new armor soldiers to be skill level one crewmen on the Abrams series tanks.

The 19K OSUT course was selected as a case study because it is one of TRADOC's most expensive individual training courses. One reason the costs are so high is the number of students who attend the course each year.

[1]OSUT training is the form of entry training that is used for most combat arms enlisted occupational specialties.

Another contributing factor to the costs of this course is the operations and maintenance cost of the Abrams series tanks. Faced with declining resources and environmental constraints, one of TRADOC's overall strategies for training is the increased use of training aids, devices, simulators, and simulations (TADSS) to substitute for the more expensive actual equipment. If cost-effective and realistic TADSS can be developed to reduce the current operating levels of a large inventory of tanks, then the operating, support, and manpower costs associated with the course can also be reduced.

TRAM's detailed approach to examining the 19K OSUT course produced several findings. First, operating and support savings are possible if training aids and devices can be substituted for training on the actual tanks. However, the level of savings depends on the type of devices and degree of substitution. Also, the level of savings is contingent on how the devices and course changes are actually implemented. Second, within the limits of our analysis, computer-based training (CBT) does not produce significant overall savings for the 19K OSUT course.[2] However, there are opportunities for using CBT in the basic portion of this course and all other basic training courses. If CBT is used for basic training events, the costs of developing and procuring the material for basic training could be spread over all basic courses, and potential economies of scale and time savings could be captured using this medium of instruction.[3]

We also found that resource and cost factors need to be reviewed and their applications standardized. In particular, the underlying assumptions of resourcing standards need to be reexamined. Many of these standards possess assumptions that have significant resource and cost consequences. For example, the structure load factor which is used to determine the number of training companies (and the associated overhead) adds two weeks to the length of the course. These weeks may be necessary, but if the factor added only one week, there could be a savings of one 19K OSUT company (25 percent of the authorizations) for FY 92. If all OSUT courses could reduce this two-week course "turn-around" period, the manpower savings could be significant. In addition, there seems to be some confusion as to which set of cost factors should be used for a given purpose. This creates a problem because the costs of training changes differ significantly depending on which cost factors are used in an analysis.[4]

The Current Course Baseline

The April 1991 POI is the critical document that provides information concerning the baseline course. The POI designates a minimum class size of 54 students, an optimal class size of

[2]Although CBT is frequently included in a TADSS strategy, we examined CBT as a separate category of analysis because it is sufficiently different from other categories of training devices and we wanted to explore the impact of CBT on basic training.

[3]A standard "rule of thumb" in the computer-based training literature is a 33 percent time efficiency. That is, the time required for CBT instruction is 66 percent of the time required for traditional classroom instruction.

[4]Even within Fort Knox, two different sets of cost factors are used to calculate operating and support costs. The Directorate of Plans, Training, and Mobilization (DPTM) uses Army Modernization Information Memorandum (AMIM), and the Directorate of Resource Management (DRM) uses Operating and Support Management Information System (OSMIS).

162 students, and a maximum class size of 165 students.[5] The student population includes both active and reserve soldiers. The 19K OSUT POI consists of 650.5 hours, which include administrative hours, exams, situational training exercises, and reinforcement training. Ninety-seven of these hours are considered "off POI" and are not a formal part of the resourcing process. That is, the training occurs on off-duty time. With the exclusion of these 97 hours, the school is able to administer the course in 14 weeks, and students are in residence at Fort Knox for the duration.[6] In our analysis, we focus on the 415 hours of the POI that are designated as academic hours. The changes we make to the POI occur in this group of POI hours. Table 5.1 summarizes the methods of instruction for these academic hours.

Table 5.1

Current 19K Instructional Methods

Method of Instruction	Hours
Conference	44.7
CBT	0.0
Demo	48.3
Practical exercise 1 tanks	159.2
Practical exercise 1 other	6.4
Practical exercise 2	132.4
Practical exercise 3	9.6
TV/seminar	14.4
Total	415.0

Proposed Alternative to the 19K OSUT Course

The alternative, which we call "the base case with TADSS substitution" makes only marginal changes in the course content, but substitutes computer-based training and selected training aids, devices, simulators, and simulations for on-tank training. This alternative was developed by the RAND job analysis method we described in Section 1. Table 5.2 highlights the major differences between the April 1991 POI—our base case—and our proposed alternative.

We add two hours to the length of the course in order to expand the overall introduction to the tank equipment. Rather than a large group of soldiers observing tanks firing and moving, we substitute videotape and computer-based training to accomplish the same objective. We use CBT in the basic and vehicle-specific portions of the course to replace some classroom teaching, demonstrations, and practical exercises. We also significantly increase the use of TADSS in the vehicle-specific portion (from 18 to 98.8 POI hours) in order to reduce the utilization of tanks. We substitute TADSS for on-tank training exercises that do not require the entire tank. For example, in training the new soldier on basic tank switches and tank start-

[5]There have been some changes in the course since this POI was developed. However, at the time of our analysis, the April '91 POI was the most current course document.

[6]The 97 hours of "off-POI" instruction are accomplished by extending the workday hours of the drill instructors and other military instructors beyond eight hours. Other training resources used in the "off-POI" instruction are "taken out of hide" according to resource analysis personnel. However, it's likely that resource exchanges are taking place in order to accomplish this training. That is, either resources are being borrowed from other sources or some degree of excess capacity is being used.

up procedures, we substitute a replica of the driver's station with fully functioning dials and switches. Additionally, in the vehicle-specific portion of the course, we substitute CBT for some conference hours, demonstrations, and practical exercises. The net effect reduces tank days per course iteration by about 50 percent. Table 5.3 contrasts the existing course hours with our proposed alternative.

Table 5.2

Base Case Compared to the Alternative

Type of Training	April '91 POI	Alternative
Academic hours	415.0	417.0
• Basic portion (60%)	249.0	249.0
—CBT event hours	0.0	46.0
—TADSS event hours	16.0	16.0
• Vehicle-specific portion (40%)	166.0	168.0
—CBT event hours	0.0	21.7
—TADSS event hours	6.0	98.8
—Tank vehicle hours	108.6	33.8
Tank days per iteration*	1,232.0	629.0

NOTE: *Tank days for one course iteration are calculated by multiplying the number of hours a training event requires tanks by the quantity of tanks required for that event. All event hours are summed and then divided by 8. Tank days are important because they are the basis for determining the inventory of tanks authorized.

Table 5.3

Comparison of Methods of Instruction

Method of Instruction	Original POI	Alternative	Difference
Conference	44.7	20.8	-23.9
CBT	0.0	67.7	67.7
Demo	48.3	35.0	-13.3
Practical exercise 1 tanks	159.2	33.8	-125.4
Practical exercise 1 other	6.4	56.4	50.0
Practical exercise 2	132.4	188.0*	55.6
Practical exercise 3	9.6	1.1	-8.5
TV/seminar	14.4	14.2	-0.2
Total	415.0	417	2.0

NOTE: *Includes 69.2 hours of *new* TADSS instruction.

Assumptions

In this application of TRAM, we also employ a "best-case" or low-cost scenario and a "worst-case" or high-cost scenario to consider different implementations of the alternative. For both scenarios we assume the changes in the course begin during FY 93. In addition, for both scenarios we assume the driver simulator is currently part of the instruction. The April 1991 POI includes this device.

Best-Case/Low-Cost Scenario. Table 5.4 lists the low-cost assumptions for our alternative, segregating assumptions by type of activity (i.e., delivery, development, and support). In

the low-cost set of delivery assumptions, we postulate that there are time savings possible using TADSS. These time savings are gained by eliminating the set-up, tear-down, and safety preparations that are required for the operations of the tanks in the motor pool and on the training ranges. Fort Knox is resourced for the set-up and preparation of the tanks for operations by multiplying total tank days by a factor of 1.25. We use a more conservative factor to determine the time savings—1.15 rather than a factor of 1.25.[7] The low-cost assumptions also include a 30 percent time savings from CBT instruction. Rather than shortening the course, we assume that the time savings are applied to those activities that are currently "off-POI" events. However, we are able to reduce the number of battalion instructors and offset the additional two hours of instruction through the time savings.[8]

Table 5.4

Low-Cost Assumptions

Training Activity	Assumption
Delivery	Training aids, devices, simulators, and simulations yield a 15% time savings CBT yields a 30% time savings Surplus tanks can be retrofitted as TADSS Required TADSS: • 27 turret trainers • 9 driver trainers (wooden mock-ups) • 14 driver training vehicles (half tanks) • 27 CBT units No TDA tank increase
Development	Estimated time values for media development TADSS development and procurement costs: • $150,000 retrofit per turret trainer • $4,000 per driver trainer • $200,000 retrofit per driver training vehicle • $3,000 per CBT system Basic training development costs may be spread over all basic training (BT) courses
Support	Low-cost logistics support

Our alternative reduces tank use, using three devices to substitute for the tanks. The first device is a driver trainer, which trains the student on how to use the basic switches and control panel of the driver's station. The device is a wooden mock-up of the driver's station with fully functioning controls. We assume in our low-cost version of the alternative that the tanks we save by using this driver trainer can be converted to TADSS. We can produce two devices from each tank we save by using the driver trainer. One of these devices is a turret trainer. The turret trainer simulates the actual operating environment for training within

[7]We use this more conservative figure because, based on a brief review of set-up and tear-down procedures for the 19K OSUT course, the 1.25 factor seems too high. It is important not to overstate the potential time savings in this area.

[8]We explain this in detail when we discuss the manpower resource changes.

the tank's turret. The turret trainer is essentially the top half of the tank—including the turret basket. The other device we can produce from the tanks we save is a driver training vehicle. This driver training vehicle is essentially the bottom half of the tank.[9]

An important decision is determining the number of devices required to substitute for the tanks. As we have shown, student input is expected to fluctuate considerably over the next several years. We decided to use the forecasted student input for FY 95 as the determining factor for the number of new TADSS, CBT equipment, and tanks required.[10] The calculation for the number of new TADSS uses the same formula that determines the number of tanks authorized. We simply determine the number of device days for one iteration of the course, the number of students per device, and the number of course iterations. Both the low- and high-cost sets of assumptions use the same number of new TADSS and CBT equipment.

The final assumption in the delivery activity area is the elimination of a recently authorized increase in the number of tanks for the 1st Armor Training Brigade. This is a cost-avoidance assumption. In March 1992, TRADOC resource management personnel determined that an additional 20 M1A1 tanks would be needed for the 1st Armor Training Brigade. In our low-cost implementation example, we assume that these additional budgeted tanks are not necessary due to the reduction in tank operating days that results from our TADSS implementation.

While the majority of our assumptions are in the delivery area, we also need to make some assumptions concerning development and support activities. Our low-cost development assumptions include using the existing TRADOC development estimated time values. Also, the cost of developing and procuring the new devices is based on the ability of the 1st Training Brigade to convert its excess tanks.[11] In addition, the development costs for the TADSS events are minimal because the same basic equipment is being used in the training. The development costs for the CBT in the basic portion of the 19K OSUT course are allocated across all basic training courses. Since these new CBT methods could be used in *all* basic training courses, the low-cost assumptions account for only 19K OSUT's portion of the development. In the support area, we assume there are no requirements for additional facilities. In addition, we use logistic support factors provided by other training locations that use similar TADSS.

Worst-Case/High-Cost Scenario. Table 5.5 lists the high-cost assumptions. The high-cost set of assumptions postulates that there are no time savings possible in using TADSS or CBT. The same number of devices and CBT equipment are needed, but the costs are higher because we do not convert tanks to TADSS. In addition, under this set of assumptions, effective with the start of FY 93, the 1st Armor Training Brigade's authorized number of tanks is increased by the TRADOC recommended number of 20 tanks.

[9]The driver training vehicle is proposed because it may reduce operating costs due to the elimination of the weight and intricacy of the turret.

[10]The 1st Armor Training Brigade Commander suggested we use the FY 95 input because the forecasts beyond FY 95 suggest approximately the same input levels as FY 95.

[11]Our estimates of the cost of retrofitting the tanks come from Aberdeen Proving Ground. This training location created turret trainers from existing tanks and maintained a record of the costs and manpower required. The retrofit cost for the half tank is based on estimates provided to Fort Knox by General Dynamics.

Our high-cost development assumptions employ the higher flat dollar rates per hour of development.[12] And, with this set of assumptions, we do not spread the basic portion development costs for CBT across all basic courses.

Table 5.5

High-Cost Assumptions

Training Activity	Assumption
Delivery	No time savings opportunities for either TADSS or CBT Surplus tanks are transferred to excess capacity at Fort Knox Required TADSS: • 27 turret trainers • 9 driver trainers (wooden mock-ups) • 14 driver training vehicles (half tanks) • 27 CBT units TDA tank increase of 20 tanks
Development	High flat dollar rates for development TADSS development and procurement costs: • $250,000 retrofit per turret trainer • $4,000 per driver trainer • 55% of M1A1 cost per driver training vehicle • $4,000 per CBT system Basic training development costs are *not* spread over all BT courses
Support	High-cost logistics support

In the support activity area, the high-cost assumptions differ from the low-cost set in logistics requirements. The factors we use for logistics support are higher and more closely parallel the logistics support factors used for the operation of the actual tanks.[13]

Once the baseline and alternatives are defined, our next step is to determine which organizations are affected by the changes and how their activities change as a result of implementing the course alternative.

ACTIVITY ANALYSIS

In this illustration of the activity analysis step, we examine the current school functions that produce the 19K OSUT course. We identify which of the organizations are affected by the change—both directly and indirectly. We then determine how their workload changes.

[12]These are the same rates that we used in the AOAC example.

[13]Operating and support data exist for turret trainers used at Aberdeen Proving Ground. However, driver training vehicles are new devices, and no data exist for operating and support costs.

Current 19K OSUT Activities

The first step in the activity analysis is to segregate the current 19K OSUT functions into the major activity areas—delivery, development, and support. Figure 5.2 lists the major 19K OSUT-related activities. The figure illustrates how we have categorized these functions that produce the 19K OSUT course.

Current 19K OSUT Delivery Functions. The 1st Armor Training Brigade is responsible for the majority of the instruction and the administration of the course. Table 5.6 shows the distribution of the 19K OSUT instruction among the various departments.

Table 5.6

19K OSUT Instruction

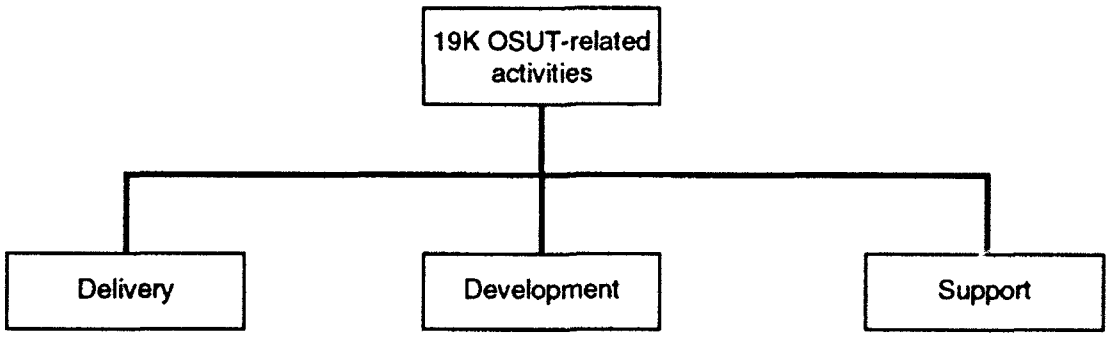
Department	Academic Hours	Percent of Total
1st Armor Training Brigade	335	81%
Training Group	70	17%
Weapons Department	10	2%
Total	415	100%

The 1st Armor Training Brigade employs one battalion of five companies to conduct its portion of the POI. The companies are subdivided into platoons of approximately 27 students. Drill instructors are also part of the 1st Brigade's manpower, and they monitor the individual soldier's progression through the course. An additional separate company within the battalion is responsible for the on-vehicle training.

Two other groups also provide instruction. The Training Group focuses on the basic portions of the course and trains first aid, engineering, communications, land navigation, and tactical intelligence. The Weapons Department conducts the driver simulation portion of the course.[14]

Delivery activities are driven by student input (including the number of course iterations per year), class size, instructional methods, and course length. Two measures of workload used in the 19K OSUT course are student load and structure load. The calculation of student load is the same formula as used in the AOAC course: class length in weeks multiplied by student input and divided by 50 weeks. Structure load is determined by multiplying student input by the course length—adding two weeks—and dividing by 50 weeks. The two weeks' extension is for course preparation and maintenance ("course turn-around") activities. The structure load determines the number of platoons and companies that are needed to instruct the course. Table 5.7 lists the student loads and structure loads forecasted for the period of FY 93 through FY 95. The workload factor of instructor contact hours determines the number of instructors who teach the vehicle-specific portion of the course.

[14]Effective May 1992, the Weapons Department and the Training Group are now part of the 1st Armor Training Brigade.



Training Departments
- 1st Armor Training Brigade
 - —Condust training
 - —Review instruction
- Weapons
- Training Group

1st Armor Training Brigade
- POI Committee
 - —Write and design lessons
 - —Develop tests
 - —Revise course documents

Directorate of Training and Doctrine
- Manage 19K SAT
- Develop courseware
- Develop scripts
- Develop training support material
- Develop, evaluate simulations

1st Armor Training Brigade
- Administer and manage training
- Maintain equipment
- Train instructors
- Manage supplies
- Manage ordinance

Directorate of Training and Doctrine
- Training publications and manuals

Directorate of Plans, Training, and Mobilization
- Manage mobilization
- Schedule courses
- Schedule equipment, ranges
- Coordinate ammunition
- Oversee brigade budgets/ resources

Directorate of Logistics
- Maintain major equipment
- Procure and manage post supply inventory

Directorate of Engineering
- Construct facilities
- Maintain facilities

Directorate of Resource Management
- Manage post budgets/ resources
- Validate ICHs

Directorate of Personnel
- Process students
- Maintain academic records

Figure 5.2—19K OSUT Activities

Table 5.7

Projected Student and Structure Loads

	FY 93	FY 94	FY 95
Student load	689	407	994
Structure load	787	465	1,136

Current 19K OSUT Development Functions. Development activities include both new training product development and sustainment activities. The POI Committee, which is part of the 1st Armor Training Brigade, is responsible for the needs assessment and needs analysis that determine the tasks to be trained in the 19K OSUT course. The POI Committee manages key course documents such as the POI. The committee also coordinates with the training departments on the design and development of the instruction for the 19K OSUT course.

The Course Development Division within the DOTD oversees the preparation of special courseware such as computer-based training and simulations and manages instructional updates based on feedback from field units and other evaluation mechanisms. The Individual Training Division works with the POI Committee in the design and development of training strategies and training support materials for the course. This division also designs and assembles soldier training publications.

Current 19K OSUT Support Functions. Within the 1st Armor Training Brigade, the management structure is determined by the traditional organization of brigades (and battalions) and the structure load. The structure load determines the number of companies, and each company is assigned two officers, four enlisted personnel, ten drill sergeants, and one civilian.

The number of tanks assigned to the TDA also determines workload for maintenance functions. Level one maintenance manpower support is determined directly by the number of tanks assigned to each battalion. Higher level maintenance within the brigade is determined by the amount of scheduled and unscheduled maintenance required for various items of equipment.

As was the case with the AOAC course, there are a number of other installation groups that support the 19K OSUT course. The Directorate of Plans, Training, and Mobilization (DPTM) is responsible for the distribution and maintenance of training aids and devices and other critical training support material. This directorate is also responsible for scheduling the course, scheduling and maintaining the ranges used in the course, coordinating ammunition use, and tracking resource usage. The Directorate of Logistics (DOL) is responsible for the maintenance of office and tactical equipment. The Directorate of Engineering and Housing (DEH) is responsible for the assignment and maintenance of housing for these students.

Identifying Organizations Affected by the Alternative

The next phase of the activity analysis step examines which organizations may be affected by the alternative. We answer the series of questions that are designed to direct us to other groups that may be affected by the change. Answering these questions is an iterative process, and as the analysis proceeds, we may need to revisit our responses to these questions. Table 5.8 is a listing of our "yes" responses for the low-cost scenario of our TADSS alternative.

Table 5.8

Identifying Other Organizations Involved in the Low-Cost TADSS Alternative

Questions	Affected Groups/Resources
Other courses are affected.	
• Which ones—prerequisites, follow-on, etc.?	All basic training (BT) courses*
Resources are being transferred.	
• Which ones?	Manpower
• Where are these coming from/where are they going?	1st ATB* to end-strength
Resources are being eliminated.	
• Which ones?	M1A1 tanks
• Which organizations or courses are affected?	1st ATB
Resources are being added.	
• Which ones?	TADSS
• Which organizations or courses may be affected?	1st ATB
Development changes affect other courses/schools.	
• Which schools or courses are affected?	All BT courses
New training products are being added.	
• Which other courses can use the products?	BT courses
Old products are being eliminated.	
• Which courses will be affected?	BT courses
These training changes affect missions of others.	
• Which missions?	Logistics
• Where are the affected missions?	School
There are changes in maintenance activities.	
• What maintenance levels are affected?	Unit and higher
Resources are available to be used for other purposes.	
• Which ones?	Tanks
• What organizations can use the resources?	1st ATB

NOTE: *Basic training includes OSUT courses. 1st ATB is the abbreviation for the 1st Armor Training Brigade.

There is one important difference in answering these questions when using a detailed/dynamic approach. We also need to determine *when* these organizations are affected by the changes, and we show how this is accomplished in the activity balance sheets.

Activity Changes Generated by the Training Alternative

We focus on the low-cost scenario throughout the remainder of the analysis to describe how the detailed approach of the method would be applied to the 19K OSUT course, and we trace the changes generated by our alternative over the period of FY 93 through FY 95. Appendix C provides discussion and balance sheets for the high-cost scenario. However, we will highlight some of the key differences between the two scenarios as we proceed through the steps of TRAM.

Changes in Delivery Activities. The FY 92 TDA for the 1st Armor Training Brigade's M1/M1A1 battalion authorizes 89 tanks. For our low-cost set of assumptions, we assume that this authorization level is not increased and that the driver trainer (wooden mock-up) can be integrated into the POI at the beginning of the second quarter of FY 93.[15] This transition is important because the course must continue while the TADSS are being developed. The substitution of the driver trainer for the actual tanks enables the 1st Armor Training Brigade to convert seven tanks to turret trainers and driver training vehicles during the second quarter of FY 93.[16] There are seven turret trainers and seven driver training vehicles that are ready for implementation at the beginning of the third quarter of FY 93. Table 5.9 shows the remainder of the implementation schedule of the TADSS for our low-cost assumptions. The columns show a cumulative total of tanks and devices. Full conversion of the tanks to TADSS is achieved by the end of the second quarter of FY 94. However, due to the reduced student input during FY 94, full implementation of the new POI can take effect beginning the first quarter of FY 94, and a total of 29 tanks are reduced.[17]

[15]According to the 1st Brigade Commander, this is a reasonable assumption because the wooden "mock-ups" of these driver trainers already exist.

[16]There are a total of 118 tank days per course iteration for the seven events in which we substitute the driver trainer for the actual tanks. After the first quarter, there are twelve remaining iterations of the course for FY 93 and 188 remaining training days. The calculation for determining excess tanks is: (118 tank days per iteration * 12 remaining iterations)/188 remaining training days.

[17]For FY 94, the student load is 1,454. There will be nine iterations of the course during FY 94. The turret trainers eliminate approximately 317 tank days per iteration and the total turret trainer requirement for FY 94 based on student input is 11.4 trainers: 317 tank days * 9 iterations/250 training days = 11.4 trainers. As of the first quarter of FY 94, our implementation schedule provided for 21 trainers. To gain additional savings, the excess turret trainers might be substituted for tank usage in other courses.

Table 5.9

TADSS Implementation: Low-Cost Assumptions

Fiscal Years	Driver Trainer	Turret Trainer	Driver Training Vehicle	Tanks
FY 93				
• 1st quarter				
• 2nd quarter	9			-7
• 3rd quarter	9	7	7	-14
• 4th quarter	9	14	14	-21
FY 94				
• 1st quarter	9	21	14	-29
• 2nd quarter	9	27	14	-29
• 3rd quarter	9	27	14	-29
• 4th quarter	9	27	14	-29

Table 5.9 illustrates that, as the different TADSS are incorporated into the POI, excess tanks can then be retrofitted and changes in instructional methods can be implemented. Tank miles are being reduced, time savings are being generated as a result of the reduction in set-up and tear-down time associated with the operation of the tanks, and instructor contact hours are changing. During FY 93, we are changing only the vehicle-specific portion of the course. We have reduced the academic hours associated with practical exercises that use tanks and have increased the academic hours that use our TADSS. We are able to save 7.5 hours as a result of time efficiencies associated with the TADSS. However, we are not decreasing the length of the course, so we note this savings as an increase in capacity. These hours' savings are an opportunity either to move "off-POI" instruction to "on-POI" instruction or to include in standard instruction training for skills that are now not taught.

Appendix C includes the TADSS implementation for our high-cost assumptions. The implementation schedule under this scenario is significantly different because the TDA authorization for tanks during FY 93 is 109 tanks, and we do not "cannibalize" existing tanks for the turrent trainers or the driver training vehicles. Full implementation of the change for our best-case scenario occurs at the beginning of FY 94. Under our high-cost assumptions, full implementation is not completed until FY 95.

Table 5.10 summarizes the delivery activity changes occurring during FY 93. We show an increasing number of tank miles saved per iteration per quarter.[18] The reason for this is, with the student load forecasted for FY 93, the nine driver trainers (DTs) and the initial seven driver training vehicles (DTVs) can fully replace the tank miles associated with their events. However, the turret trainers will have to be implemented incrementally. That is, for the third quarter of FY 93, the turret trainers (TTs) can provide 35 percent replacement of tank miles. For the fourth quarter of FY 93, there are enough turret trainers to replace 55 percent of the tank miles. By the beginning of FY 94, there are sufficient turret trainers to fully substitute for the tank miles generated by the forecasted student load.

[18]Each balance sheet shows the changes compared to the baseline course.

Table 5.10

FY 93 Changes in Delivery Activities: Low-Cost Assumptions

	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
AIT VEHICLE-SPECIFIC PORTION					
PE-1 with tanks (academic hours)	-49.5 hours				-49.5 hours
PE-2 with TADSS (academic hours)		+42 hours	+7.5 hours		+49.5 hours
Tank miles per iteration					
• 1st quarter	0				0
• 2nd quarter (DT)	-151 miles				-151 miles
• 3rd quarter (DT, TT)	-340 miles				-340 miles
—Tank miles	-4,660 miles				-4,660 miles
—Driver trainer miles		+4,660 miles			+4,660 miles
• 4th quarter (DT, TT, DTV)	-448 miles				-448 miles
TOTAL FY 93 TANK MILES	-45,993 miles				-45,993 miles
TOTAL FY 93 DTV		+41,940 miles			+41,940 miles
Battalion ICHs per iteration*					
• 1st quarter	0				0
• 2nd quarter (DT)	-105 ICHs				-105 ICHs
• 3rd quarter (DT, TT, DTV)	-333 ICHs				-333 ICHs
• 4th quarter (DT, TT, DTV)	-406 ICHs				-406 ICHs
TOTAL FY 93 ICHs	-3,677 ICHs				-3,677 ICHs

NOTE: *We list only the battalion ICH changes because this is the only group that is affected by our changes in ICHs. The Weapons Department is also resourced according to ICHs, but we have not changed their instructional events.

Table 5.11 separates the two major portions of the course—the AIT vehicle-specific and basic portions. We separate these two portions of the course because the changes in the 19K OSUT basic portion apply to all basic training. The basic portion of the balance sheet highlights the time savings opportunities for CBT instruction. In the AIT vehicle-specific portion of the course, we are again able to gain some time efficiencies using TADSS and CBT. In this case, we use some of the time savings to cover the additional two hours of instruction we have added to the POI.

Table 5.11

FY 94 Changes in Delivery Activities: *Low-Cost Assumptions*

	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
AIT VEHICLE-SPECIFIC ACADEMIC HOURS					
PE-1 with tanks	-74.8 hours				-74.8 hours
PE-2 with TADSS		+58.8 hours	+10.4* hours		+69.2 hours
Conference	-5 hours				-5 hours
CBT		+15.2 hours	+6.5* hours	-2* hours	+19.7 hours
Demo	-8.7 hours				-8.7 hours
PE-3	-0.5 hours				-0.5 hours
TV		+0.1 hours			+0.1 hours
VEHICLE-SPECIFIC TOTALS	-89 hours	+74.1 hours	+16.9* hours	-2 hours	0 hours
OTHER VEHICLE-SPECIFIC					
Tank miles per iteration	-691 miles				-691 miles
Tank miles converted TOTAL FY 94 Driver trainer miles TOTAL FY 94	-4,660 miles -48,159 miles	 +4,660 miles +41,940 miles			-4,660 miles -48,159 miles +4,660 miles +41,940 miles
Battalion ICHs TOTAL FY 94	-804 ICHs -7,236 ICHs				-804 ICHs -7,236 ICHs
BASIC TRAINING PORTION					
PE-1	-0.6 hours				-0.6 hours
PE-2	-13.6 hours				-13.6 hours
PE-3	-8 hours				-8 hours
Conference	-18.9 hours				-18.9 hours
CBT		+32.2 hours	+13.8 hours		+46 hours
Demo	-4.6 hours				-4.6 hours
TV	-0.3 hours				-0.3 hours
BASIC TRAINING HOURS TOTAL	-46 hours	+32.2 hours	+13.8 hours		0 hours

NOTE: *We are able to reduce off-POI hours and assimilate our additional two instructional hours through the time savings generated by the TADSS and CBT.

The FY 95 changes compared to our baseline are the same as those presented in Table 5.11. However, the total changes for each year for academic hours, miles, and ICHs are driven by the forecasted student input. For FY 93, the Army Program for Individual Training (ARPRINT) forecasts a total of 2,461 students attending the course. Fifteen iterations of the course are planned for FY 93, nine iterations are planned for FY 94, and 22 iterations for FY 95. Table 5.12 shows how the changes in student input affect the ICHs and miles for each year.

Table 5.12

Summary of Low-Cost Assumption Delivery Changes by Fiscal Year

	FY 93	FY 94	FY 95
Student Input	2,641	1,454	3,550
Annual iterations	15	9	22
Total ICHs	-3,677	-7,236	-17,688
Tank miles converted to DTV*	41,940	41,940	102,520
Total tank miles reduced	-4,053	-6,219	-15,202

NOTE: *We highlight the conversion of miles from the tanks to the driver training vehicle because there are important resource and cost differences between the two types of equipment.

There are significant differences between the changes in delivery activities for the low-cost assumptions and the high-cost assumptions.[19] Under the high-cost assumptions, fewer miles are converted during FY 93 and FY 94. The reason for this is that we do not convert the surplus tanks into turret trainers or driver training vehicles. These trainers must be procured. We are also unable to save as many instructor contact hours under the high-cost assumption implementation period because the course must continue until the training devices can be fully integrated into the course.

Changes in Development Activities. Our next step is to measure the changes in development activities. We first need to determine how many new products need to be developed and when they are to be developed. We then need to determine which baseline products no longer need to be sustained. During FY 93 there are a total of 213 training products that need to be developed. Of these, 123 products are for the vehicle-specific portion of the course, and 88 products are for the basic portion of the course. We are changing several practical exercises that use tanks during FY 93 and are able to eliminate the sustainment of 32 products associated with these exercises. In addition, we need to account for the development of the

[19]Tables C.2, C.3, C.4, and C.5 in Appendix C detail the differences between the two sets of assumptions.

instructor training that will be needed for the new CBT events. Table 5.13 shows the changes in development activities for FY 93. The net change column in Table 5.13 shows the difference in the number of instructional products that need to be sustained and the increase column shows the number of new products that need to be developed during this fiscal year.[20]

Table 5.13

FY 93 Changes in Development Activities: Low-Cost Assumptions

Instructional Products	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference		+24			+24
CBT		+18			+18
Demonstration		+33			+33
PE-1	-32	+9			-23
PE-2		+1			+1
PE-2 with TADSS		+32			+32
PE-3		+2			+2
TV		+4			+4
TOTAL VEHICLE-SPECIFIC	-32	+123			+91
BASIC TRAINING					
Conference		+8			+8
CBT		+37			+37
Demonstration		+9			+9
PE-1		+8			+8
PE-2		+16			+16
PE-2 with TADSS		0			0
PE-3		0			0
TV		+10			+10
TOTAL BASIC		+88			+88
Revise instructor course POI	-1	+1			0
Revise course POI	-1	+1			0
TOTAL	-34	213			179

[20]Our low-cost assumptions postulate that all one-time development activity changes can be accomplished during FY 93.

Once we know the specific development products, we can translate these products into changes in workload factors for training development. Table 5.14 summarizes the changes in man-years for training development activities during FY 93. During FY 93, we can reduce current sustainment activities by two man-years. However, our one-time development activities require an additional 15.2 man-years. Our overall net change for developers is 13.2 man-years. In the current budget reduction climate, it is not likely the Army will add 13 developers to its full-time staff. It is more likely the increased development will be accomplished using outside contractors or temporary workers. However, the balance sheets provide the amount of development activity changes that need to be resourced.

Table 5.14

FY 93 Changes in Development Man-Years: Low-Cost Assumptions

Instructional Products	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference		+3			+3
CBT		+3			+3
Demonstration		+3			+3
PE-1	-2	+1			-1
PE-2		0			0
PE-2 with TADSS		+3			+3
PE-3		0			0
TV		+1			+1
TOTAL VEHICLE-SPECIFIC	-2	+14			+12
BASIC TRAINING					
Conference		+0.1			+0.1
CBT		+0.5			+0.5
Demonstration		+0.1			+0.1
PE-1		+0.1			+0.1
PE-2		+0.2			+0.2
PE-2 with TADSS		0			0
PE-3		0			0
TV		+0.2			+0.2
TOTAL BASIC		+1.2			+1.2
Revise instructor course POI	-0	0			0
Revise course POI	-0	0			0
TOTAL	-2	+15.2			+13.2

The completion of the development activities during FY 93 enables us to eliminate more sustainment activities for changed events. However, there are new sustainment activities associated with the revision of the course. Table 5.15 shows the changes in development sustainment activities for FY 94. The net change column shows that our alternative adds 74 products. The majority of these additional products are in the vehicle-specific portion of the course.

Table 5.15

FY 94 Changes in Development Sustainment Activities: Low-Cost Assumptions

Instructional Products	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference	-15	+24			+9
CBT		+18			+18
Demonstration	-15	+33			+18
PE-1	-34	+9			-25
PE-2		+1			+1
PE-2 with TADSS		+32			+32
PE-3	-1	+2			+1
TV	-1	+4			+3
TOTAL VEHICLE-SPECIFIC	-66	+123			+57
BASIC TRAINING					
Conference	-40	+8			-32
CBT		+37			+37
Demonstration	-15	+9			-6
PE-1	-3	+8			+5
PE-2	-7	+16			+9
PE-2 with TADSS	0	0			0
PE-3	-5	0			-5
TV	-1	+10			+9
BASIC TOTAL	-71	+88			+17
Instructor course POI	-1	+1			0
Course POI	-1	+1			0
TOTAL COURSE	-139	+213			+74

We also must convert the changes in product sustainment into man-years. Table 5.16 shows the changes for FY 94 in terms of developer man-years. To sustain this change we need one additional training developer. The changes in development sustainment activities that occur in FY 94 continue through FY 95.

Table 5.16

FY 94 Changes in Development Sustainment Man-Years: Low-Cost Assumptions

Instructional Products	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference	-0.9	+1.5			+0.6
CBT		+1.5			+1.5
Demonstration	-0.8	+1.5			+0.7
PE-1	-2.4	+0.5			-1.9
PE-2		0			0
PE-2 with TADSS		+1.5			+1.5
PE-3	-0.1	0			-0.1
TV	-0.1	+0.5			+0.4
TOTAL VEHICLE-SPECIFIC	-4.3	+7			+2.7
BASIC TRAINING					
Conference	-0.2	0			-0.2
CBT		+0.3			+0.3
Demonstration	-0.8	0			-0.8
PE-1	-0.2	0			-0.2
PE-2	-0.5	+0.1			-0.4
PE-2 with TADSS	0	0			0
PE-3	-0.4	0			-0.4
TV	-0.1	+0.1			0
BASIC TOTAL	-2.2	+0.5			-1.7
TOTAL COURSE	-6.5	+7.5			+1

The major difference between the low-cost and high-cost assumptions in the development activity area is the unit of measure. In the low-cost assumptions, we estimate changes in development hours. In the high-cost assumptions, we examine individual product hours. Appendix C summarizes the product hours calculations for our high-cost scenario.

Changes in Support Activities. There are a number of important changes in support activities, and Table 5.17 highlights these changes for FY 93. First, we are able to reduce unit level maintenance for the tanks. To calculate the change in workload, we use the MS3 standard for level one maintenance personnel.[21] We also use the MS3 standard for brigade and battalion level two maintenance to calculate this activity's changes in monthly maintenance hours.[22] We estimate these hours by using maintenance information provided by the Aberdeen Proving Ground and other installations using these types of TADSS.

The balance sheet notes two other groups, the DOTD and the DOL, that are affected by the changes in the course. The DOTD must provide the publications that result from new training products. We also include the effect of the reduction in mileage for DOL's higher level maintenance function. This function's workload factor is based on equipment miles.

Table 5.17

FY 93 Change in Support Activities: Low-Cost Assumptions

Support Activities	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
1ST ARMOR TRAINING					
• Level one maintenance monthly maintenance hours					
• Tank maintenance	-1,360 hours				-1,360 hours
• DT maintenance		+112 hours			+112 hours
• Turret trainers		+464 hours			+464 hours
• DTV		+194 hours			+194 hours
• Battalion/Brigade monthly maintenance hours					
• Tank maintenance	-1,265 hours				-1,265 hours
• DT maintenance		+100 hours			+100 hours
• Turret trainers		+392 hours			+792 hours
• DTV		+175 hours			+175 hours
• CBT		+115 hours			+115 hours
Initial instructor training					
• Drill instructors		+1 week			+1 week
• Training group		+1 week			+1 week
• Battalion		+1 week			+1 week
Replacement training		+1 week			+1 week
DOTD					
Publications	-34 old	+213 new			+179 publications
DOL					
Higher level maintenance					
• Tank miles	45,993 miles				-45,993 miles
• DTV miles		+41,940 miles			+41,940 miles

[21]This standard assumes a monthly maintenance requirement of 64.75 hours per tank.

[22]This is a two-phase standard. The first part of the standard is a calculation of the indirect maintenance hours required for each tank (38.66 hours * number of tanks). The result of this equation is then included in the equation that calculates total maintenance hours [5578 * (38.66 * number of tanks)] + (38.66 * number of tanks).

Table 5.18 is the support activity balance sheet for FY 94. We are able to further reduce the unit and higher level maintenance activities through the reduction in monthly tank maintenance hours and mileage.

Table 5.18

FY 94 Change in Support Activities: Low-Cost Assumptions

Support Activities	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
1ST ARMOR TRAINING					
Level one monthly maintenance hours					
• Tank maintenance	-1,878 hours				-1,878 hours
• DT maintenance		+112 hours			+112 hours
• Turret trainers		+882 hours			+882 hours
• DTV		+194 hours			+194 hours
Higher level maintenance					
• Tank maintenance	-1,746 hours				-1,746 hours
• DT maintenance		+100 hours			+100 hours
• Turret trainers		+792 hours			+792 hours
• DTV		+175 hours			+175 hours
• CBT		+115 hours			+115 hours
Replacement training		+1 week			+1 week
DOTD					
Publications	-139 old	+213 new			+74 publications
DOL					
Higher level maintenance					
• Tanks	-48,159 miles				-48,159 miles
• DTV		+41,940 miles			+41,940 miles

The support changes for FY 95 are the same as those that occur in FY 94 except that the mileage savings are different. For FY 95 there is a reduction of 117,722 tanks miles and a conversion of 102,520 miles to the driver training vehicle.

The major difference between our low-cost assumptions and our high-cost assumptions in the support activity area is the transition activities. While the new training devices are being developed and procured, maintenance activities must continue in the interim.[23]

Having identified the activity changes for the years included in our analysis, we now document the changes in resources that result from implementing this alternative. The resource analysis uses the year-by-year changes identified in the activity analysis and traces the resource changes for the same period of time.

[23]Appendix C details these maintenance requirements.

RESOURCE ANALYSIS

Our first step in the resource analysis is to summarize the activity changes by year. We also make an initial estimate as to the recurring or one-time character of these changes. Table 5.19 is the catalogue of activity changes for FY 93. Significant changes in activities and workload in training delivery, development, and support occur.

Table 5.19

FY 93 Catalogue of TADSS Alternative Activity and Workload Changes: Low-Cost Option

	Type of Activity	
Activity/Workload Changes	One-time/Transition?	Recurring?
DELIVERY		
1st Armor Training Brigade (-3,677 ICHs)		X
Tank training (-45,993 miles)		X
DTV training (41,940 miles)		X
DEVELOPMENT		
New product development (+13.2 man-years)	X	
SUPPORT		
Level one maintenance		
• Tank maintenance (-1,320 hours)		X
• DT maintenance (+112 hours)		X
• Turret trainer maintenance (+464 hours)		X
• DTV maintenance (+194 hours)		X
Battalion/Brigade maintenance		
• Tank maintenance (-1,265 hours)		X
• DT maintenance (+100 hours)		X
• Turret trainer maintenance (+392 hours)		X
• DTV maintenance (+175 hours)		X
• CBT (+115 hours)		X
Initial instructor training		
• Drill instructors (+1 week)	X	
• Training group (+1 week)	X	
• Battalion (+1 week)	X	
Replacement training (+1 week)		X
Publications (-34 old/+213 new)	X	X
Higher level maintenance		
• Tank miles (-45,933 miles)		X
• DTV (+41,940 miles)		X

Table 5.20 summarizes the activity changes for FY 94. There is an increase in the number of ICHs we are able to reduce during this year. We also need to retain one of the temporary developers in order to meet the product sustainment requirements for training development.

Table 5.20

FY 94 Catalogue of TADSS Alternative Activity and Workload Changes: Low-Cost Option

	Type of Activity	
Activity/Workload Changes	One-time/Transition?	Recurring?
DELIVERY		
1st Armor Training Brigade (-7,239 ICHs)		X
Tank miles (-48,159 miles)		X
DTV miles (+41,940 miles)		X
DEVELOPMENT		
Development sustainment (+1 man-year)		X
SUPPORT		
Level one maintenance		
• Tank maintenance (-1,878 hours)		X
• DT maintenance (+112 hours)		X
• Turret trainer maintenance (+882 hours)		X
• DTV maintenance (+194 hours)		X
Battalion/Brigade maintenance		
• Tank maintenance (-1,746 hours)		X
• DT maintenance (+100 hours)		X
• Turret trainer maintenance (+792 hours)		X
• DTV maintenance (+175 hours)		X
• CBT (+115 hours)		X
Replacement training (+1 week)		X
Publications (+74 new)		X
Higher level maintenance		
• Tank miles (-48,159 miles)		X
• DTV (+41,940 miles)		X

Table 5.21 summarizes the activity changes for FY 95. The reduction in tank miles increases significantly during this year. If we had not substituted our TADSS for tank use, the FY 95 mileage would have been much greater due to the increase in student input.

Table 5.21

FY 95 Catalogue of TADSS Alternative Activity and Workload Changes: Low-Cost Option

	Type of Activity	
Activity/Workload Changes	One-time/Transition?	Recurring?
DELIVERY		
1st Armor Training Brigade (-17,688 ICHs)		X
Tank miles (-117,722 miles)		X
DTV miles (+102,520 miles)		X
DEVELOPMENT		
Development sustainment (+1 man-year)		X
SUPPORT		
Level one maintenance		
• Tank maintenance (-1,878 hours)		X
• DT maintenance (+112 hours)		X
• Turret trainer maintenance (+882 hours)		X
• DTV maintenance (+194 hours)		X
Battalion/Brigade maintenance		
• Tank maintenance (-1,746 hours)		X
• DT maintenance (+100 hours)		X
• Turret trainer maintenance (+792 hours)		X
• DTV maintenance (+175 hours)		X
• CBT (+115 hours)		X
Replacement training (+1 week)		X
Publications (+74 new)		X
Higher level maintenance		
• Tank miles (-48,159 miles)		X
• DTV (+41,940 miles)		X

The resource analysis step of the method produces the specific manpower, equipment/supplies/materiel, and facilities changes that result from implementing our TADSS alternative. To catalogue these changes, we proceed as we did with the activity analysis—using the balance sheet to record the specific changes in manpower and equipment.[24]

Manpower Changes

As we did with the AOAC course, we treat changes in military manpower for the 19K OSUT course as transfers to other organizations. Table 5.22 is the FY 93 balance sheet for changes in manpower generated by the low-cost TADSS alternative. In FY 93, we can eliminate two

[24]There are no facilities changes for our alternative.

tank commanders and reduce maintenance personnel.[25] However, we need to add temporary developers. The balance sheet also notes the type of manpower changes—one-time or recurring.

In addition to the workload changes, we need to examine other sources of information in determining the specific changes in resources. For example, to determine the rank of the tank commanders, maintenance personnel, and GS level of developers, we need to refer to the 1st Armor Training Brigade's TDA document.

Table 5.22

FY 93 TADSS Alternative Manpower Balance Sheet: Low-Cost Assumptions

	School Decrease	School Increase	Excess Capacity	Transfers to Other Organizations	Net Change	O.T./Rec.
Delivery • Military (grade) • Civilian (grade)	-2 E-6			+2 E-6		O.T./Rec.
Development • Civilian (grade)	+15 GS-9	-2 GS-9			+13 GS-9	O.T./Rec.
Support • Military (grade)	-9 E-3 -8 E-4	+5 E-3 +5 E-4		+4 E-3 +3 E-4		O.T./Rec. O.T./Rec.

NOTE: O=officer, E=enlisted, O.T.=one-time, Rec.=recurring

Table 5.23 summarizes the changes in manpower for FY 94. There are one-time and recurring resource changes associated with reducing or adding personnel. In our detailed approach, we need to track these separately. The balance sheet shows the need to add one developer to sustain the changes in training development products. For the changes in military personnel we note the incremental changes in parentheses and the figures outside the parentheses show the cumulative manpower for both FY 93 and FY 94. For example, there will be a one-time transfer of three tank commanders this year. However, we have saved a recurring total of five tank commanders during this fiscal year.[26]

[25]To calculate reduction in 1st Battalion tank commanders the formula is 1.2651 * monthly ICHs/145. The calculation for instructor aides (level one maintenance) is 64.761 * number of tanks/145. The 64.761 is the monthly level one maintenance hours per tank.

[26]These tank commanders are a reduction in manpower requirements for the Armor School, but there may not be a total reduction in Army end-strength. As a result, we summarize these military manpower changes separately.

Table 5.23

FY 94 TADSS Alternative Manpower Balance Sheet: Low-Cost Assumptions

	School Decrease	School Increase	Excess Capacity	Transfers to Other Organizations	Net Change	O.T./Rec.
Delivery • Military (grade) • Civilian (grade)	(-3)/-5 E-6			(+3)/+5 E-6		O.T./Rec.
Development • Civilian (grade)		+1 GS-9			+1 GS-9	O.T./Rec.
Support • Military (grade)	(-4)/-13 E-3 (-4)/-12 E-4	(+3)/+8 E-3 (+3)/+8 E-4		(+1)/+5 E-3 (+1)/+4 E-4		O.T./Rec. O.T./Rec.

Table 5.24 summarizes the manpower changes that occur during FY 95. By this time, our requirement for tank commanders is 13 less than the current baseline. Our requirement for level one maintenance personnel is five less than the baseline. And our requirement for level two maintenance personnel is four less than the current baseline.[27] However, we do have the recurring requirement for one additional training developer.

Table 5.24

FY 95 TADSS Alternative Manpower Balance Sheet: Low-Cost Assumptions

	School Decrease	School Increase	Excess Capacity	Transfers to Other Organizations	Net Change	O.T./Rec.
Delivery • Military (grade)	(-8)/-13 E-6			(+8)/+13 E-6		O.T./Rec.
Development • Civilian (grade)		+1 GS-9				Rec.
Support • Military (grade)	(0)/-13 E-3 (0)/-12 E-4	(0)/+8 E-3 (0)/+8 E-4		(0)/-5 E-3 (0)/-4 E-4		Rec. Rec.

Equipment Changes

We track the changes in equipment resources in the same manner as manpower. Table 5.25 summarizes the equipment changes during FY 93. For CBT, we have a one-time cost associated with spares because we need to secure initial stock of spare parts. However, there are no one-time costs associated with the TADSS spares because we are able to convert the current M1/M1A1 stock to TADSS spares.

[27]The (0) entries in the balance sheet note that there are no one-time resource changes.

Table 5.25

FY 93 TADSS Alternative Equipment Balance Sheet: Low-Cost Assumptions

	School Decrease	School Increase	Other	Excess Capacity	Net Change	O.T./Rec.
Delivery						
• Tanks	-21		+21 tanks to TADSS			Rec.
• DT		+9			+9 DT	O.T./Rec.
• TT		+14			+14 TT	O.T./Rec.
• DTV		+14			+14 DTV	O.T./Rec.
• CBT		+27			+27 CBT	O.T./Rec.
Support						
• DT spares		+9			+9	Rec.
• CBT spares		+27			+27	O.T./Rec.
• M1A1 spares	-21		+21 tank spares to TADSS			Rec.
• TT spares		+14			+14	Rec.
• DTV spares		+14			+14	Rec.

Table 5.26 summarizes the changes in equipment for FY 94. During this year, we must record the final retrofitting for the turret trainers. This one-time change is noted in the parentheses. However, for the remaining devices we have no additional incremental changes, so we simply note the recurring resource changes. We are also able to transfer two additional tanks to excess capacity.

Table 5.26

FY 94 TADSS Alternative Equipment Balance Sheet: Low-Cost Assumptions

	School Decrease	School Increase	Other	Excess Capacity	Net Change	O.T./Rec.
Delivery						
• Tanks	-29		+27 tanks to TADSS	+2 tanks		Rec.
• DT		(0)/+9			+9 DT	Rec.
• TT		(+13)/+27			+27 TT	O.T./Rec.
• DTV		(0)/+14			+14 DTV	Rec.
• CBT		(0)/+27			+27 CBT	Rec.
Support						
• DT spares		+9			+9	Rec.
• CBT spares		+27			+27	Rec.
• M1A1 spares	-29		+27 tank spares to TADSS	+2		Rec.
• TT spares		+27			+27	Rec.
• DTV spares		+14			+14	Rec.

Table 5.27 summarizes the changes in equipment for FY 95. All one-time resource changes have been accomplished, and the changes represented in this table are the recurring changes in equipment that result from our TADSS alternative. Because there are no facilities changes that result from our TADSS alternative, the completion of the yearly resource balance sheets means we can proceed to the cost analysis step of the method.

Table 5.27

FY 95 TADSS Alternative Equipment Balance Sheet: Low-Cost Assumptions

	School Decrease	School Increase	Other	Excess Capacity	Net Change	O.T./Rec.
Delivery						
• Tanks	-29		+27 tanks to	+2 tanks		Rec.
• DT		+9	TADSS		+9 DT	Rec.
• TT		+27			+27 TT	Rec.
• DTV		+14			+14 DTV	Rec.
• CBT		+27			+27 CBT	Rec.
Support						
• DT spares		+9			+9	Rec.
• CBT spares		+27			+27	Rec.
• M1A1 spares	-29		+27 tank spares	+2		Rec.
• TT spares		+27	to TADSS		+27	Rec.
• DTV spares		+14			+14	Rec.

C)ST ANALYSIS AND COSTS IN CONTEXT

In this step, we calculate the net costs and savings of changes in activities and resources. Because we are using a detailed approach, we calculate the changes for each year.

Catalogue of Cost-Causing Changes

Tables 5.28 through 5.30 list the cost-causing changes for our low-cost assumptions for the period of FY 93 through FY 95. The majority of transition or one-time resource expenditures occurs during FY 93. These resource changes and the attendant expenditures would need to have been programmed in advance for FY 93. Changes in training strategy need to be identified early in order to incorporate the changes into the planning cycle. Planning for changes can help identify the one-time activities required to implement the changes.

Table 5.28

FY 93 Catalogue of Cost-Causing Changes for TADSS Alternative

	Basis for Estimate	Nonrecurring	Recurring
DELIVERY			
1st Armor Training Brigade	-3,677 ICHs		X
Tank training	-45,993 miles		X
DTV training	+41,940 miles		X
DEVELOPMENT			
New product development	+13.2 man-years	X	
SUPPORT			
Level one maintenance			
• Tank maintenance	-1,320 hours		X
• DT maintenance	+112 hours		X
• Turret trainer maintenance	+464 hours		X
• DTV maintenance	+194 hours		X
Battalion/Brigade maintenance			
• Tank maintenance	-1,265 hours		X
• DT maintenance	+100 hours		X
• Turret trainer maintenance	+392 hours		X
• DTV maintenance	+175 hours		X
• CBT	+115 hours		X
Initial instructor training	+1 week		X
Replacement training	+1 week		X
Publications	-34 old/+213 new	X	X
Higher level maintenance			
• Tank miles	-45,933 miles		X
• DTV miles	+41,940 miles		X
MANPOWER			
Civilians			
• GS-9	+13 temporary GS-9	X	
Military transfers			
• Tank commanders (E-6)	+2	X	
• Level one maintenance (E-3)	+4	X	
• Level two maintenance (E-4)	+3	X	
EQUIPMENT			
M1/M1A1 tank spares	-21		X
DT/DT spares	+9	X	X
Turret trainers/TT spares	+14	X	X
DTV/DTV spares	+14	X	X
CBT	+27	X	X
CBT spares	+27	X	X

Table 5.29

FY 94 Catalogue of Cost-Causing Changes for TADSS Alternative

	Basis for Estimate	Nonrecurring	Recurring
DELIVERY			
1st Armor Training Brigade	-7,239 ICHs		X
Tank training	-48,159 miles		X
DTV training	+41,940 miles		X
DEVELOPMENT			
Product sustainment	+1 man-year		X
SUPPORT			
Level one maintenance			
• Tank maintenance	-1,878 hours		X
• DT maintenance	+112 hours		X
• Turret trainer maintenance	+882 hours		X
• DTV maintenance	+194 hours		X
Battalion/Brigade maintenance			
• Tank maintenance	-1,746 hours		X
• DT maintenance	+100 hours		X
• Turret trainer maintenance	+792 hours		X
• DTV maintenance	+175 hours		X
• CBT	+115 hours		X
Replacement training	+1 week		X
Publications	+74 new		X
Higher level maintenance			
• Tank miles	-48,159 miles		X
• DTV miles	+41,940 miles		X
MANPOWER			
Civilians			
• GS-9	+1 GS-9		X
Military transfers			
• Tank commanders (E-6)	(+3)/+5*	X	X
• Level one maintenance (E-3)	(+1)/+4	X	X
• Level two maintenance (E-4)	(+1)/+3	X	X
EQUIPMENT			
M1/M1A1 tank spares	-27		X
DT/DT spares	(0)/+9		X
Turret trainers/TT spares	(+13)/+27	X	X
DTV/DTV spares	(0)/+14		X
CBT	(0)/+27		X
CBT spares	(0)+27		X

NOTE: *Figures in the parentheses are the incremental one-time changes for the year.

Table 5.30

FY 95 Catalogue of Cost-Causing Changes for TADSS Alternative

	Basis for Estimate	Nonrecurring	Recurring
DELIVERY			
1st Armor Training Brigade	-17,688 ICHs		X
Tank training	-117,722 miles		X
DTV training	+102,520 miles		X
DEVELOPMENT			
Product sustainment	+1 man-year		X
SUPPORT			
Level one maintenance			
• Tank maintenance	-1,878 hours		X
• DT maintenance	+112 hours		X
• Turret trainer maintenance	+882 hours		X
• DTV maintenance	+194 hours		X
Battalion/Brigade maintenance			
• Tank maintenance	-1,746 hours		X
• DT maintenance	+100 hours		X
• Turret trainer maintenance	+792 hours		X
• DTV maintenance	+175 hours		X
• CBT	+115 hours		X
Replacement training	+1 week		X
Publications	+74 new		X
Higher level maintenance			
• Tank miles	-117,722 miles		X
• DTV miles	+102,520 miles		X
MANPOWER			
Civilians			
• GS-9	+1 GS-9		X
Military transfers			
• Tank commanders (E-6)	(+8)/+13	X	X
• Level one maintenance (E-3)	(+0)/+5		X
• Level two maintenance (E-4)	(+0)/+4		X
EQUIPMENT			
M1/M1A1 tanks	-27		X
DT	+9		X
Turret trainers	+14		X
DTV	+14		X
CBT	+27		X
CBT spares	+27		X

The catalogues of cost-causing changes for each year provide the foundation for calculating the costs for each fiscal year. Our next step is to take these changes and incorporate them into our cost model. Table 5.31 is the general cost model for our low-cost assumptions, which we use to calculate the costs for each year. We initially calculate the costs using FY 93 constant dollars for each fiscal year in our analysis. Appendix A provides information on the cost factors we use in this model. Appendix C contains the specific results for each fiscal year for both our low- and high-cost scenarios.

Table 5.31

General Model for TADSS Alternative

Cost Changes	Resource Changes						
		Manning		Equipment		Facilities	
	Activity Level	Amount	Type	Amount	Type	Amount	Type
NONRECURRING COSTS							
Civilian personnel cost							
• Acquisition		X	X				
• Initial training		X	X				
• Separation		X	X				
• Transfer		X	X				
Military personnel cost							
• Initial training		X	X				
• Transfer		X	X				
New training products		X	X				
Equipment procurement	X			X	X		
Equipment transfer	X			X	X		
Initial spares/stock				X	X		
RECURRING COSTS							
Civilian personnel cost							
• Replacement acquisition		X	X				
• Replacement training		X	X				
• Pay		X	X				
• Allowances		X	X				
Military personnel cost							
• Replacement training		X	X				
Training product maintenance		X	X				
Fuel, oil, etc. (POL)	X			X	X		
Replenishment spares	X			X	X		
Equipment maintenance	X	X	X	X	X		
Product distribution	X			X	X		
Product reproduction	X	X	X				

Costs in Context

In substituting TADSS and CBT for hands-on training in the 19K OSUT course, there are several things that the decision maker needs to know. First, the decision maker needs to know that we are examining a "favored alternative" and we have detailed the changes in costs over time. In our AOAC example, we were screening many alternatives and used a simple break-even analysis to determine which of these alternatives warrant further study. In this 19K case study, we are examining alternative implementations of a favored alternative.

Cost Comparisons. Figure 5.3 illustrates the constant dollar flow over the period of FY 93 through FY 95 for both our best-case or low- and worst-case or high-cost scenarios.[28] By converting the tanks and retrofitting them for TADSS, we are able to begin to accrue savings almost immediately. However, if we must procure new TADSS, our costs are significantly higher, and we do not begin to recover any savings until the later part of FY 94.

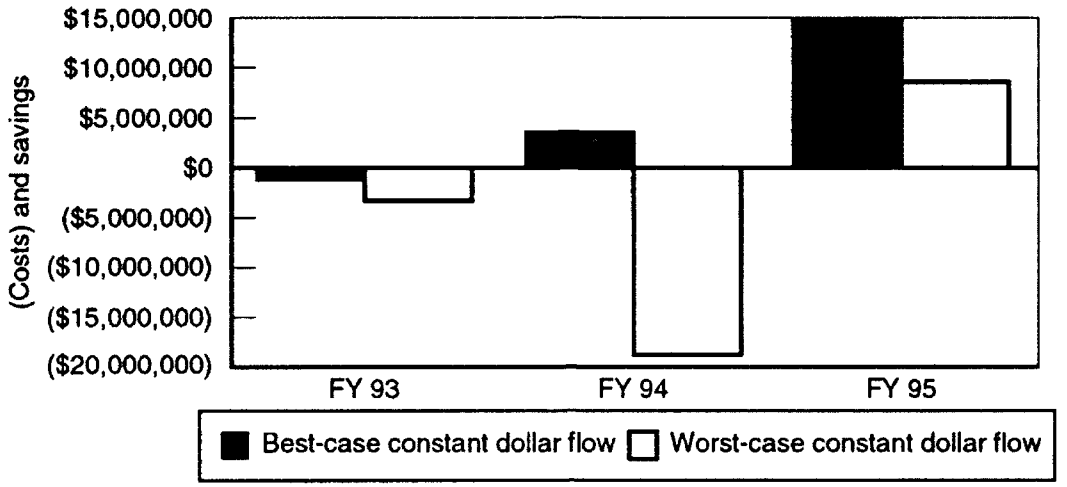


Figure 5.3—Constant Dollar Flow of Alternatives

The decision maker will also need to know the differences in the two alternatives using current dollars for budget projections. Table 5.32 shows the net present value for our low-cost TADSS alternative using current dollars and a real discount rate of 10 percent. We use a 10 percent discount rate because this is the current required discount rate for Army cost studies.[29]

Table 5.32

Net Present Value of Low-Cost TADSS Alternative

	Savings	Costs	Discount Factor	Net Present Value Savings	Net Present Value Costs
FY 93	$4,927,700	$5,926,200	0.00	$4,927,700	$5,926,200
FY 94	$5,234,900	$2,232,600	0.91	$4,759,048	$2,029,657
FY 95	$13,359,000	$24,400	0.83	$11,039,878	$20,164
Total	$23,521,600	$8,183,200		$20,726,625	$7,976,021

[28]We use constant dollars here to reflect the general purchasing power of the dollars at the time of the decision. Relating costs and savings in terms of constant dollars allows for a direct comparison of changes from year to year prior to the introduction of inflationary cost factors.

[29]Army Cost and Economic Analysis Center (CEAC).

Table 5.33 shows the net present value for our high-cost TADSS alternative. For the period of FY 93 through FY 95, our high-cost alternative captures a limited amount of savings and generates significant costs. If we extrapolate into the future the savings and costs for the high-cost scenario, we do not break even until FY 98.

Table 5.33

Net Present Value of High-Cost TADSS Alternative

	Savings	Costs	Discount Factor	Net Present Value Savings	Net Present Value Costs
FY 93	$55,200	$3,652,900	0.00	$55,200	$3,652,900
FY 94	$55,600	$18,256,300	0.91	$50,546	$16,596,802
FY 95	$7,559,900	$15,400	0.83	$6,247,501	$12,727
Total	$7,670,700	$21,924,600		$6,353,247	$20,262,429

As was the case for the AOAC course, there are also special considerations for the 19K OSUT course that involve military manpower changes. Table 5.34 is a summary of the military manpower changes that result from both the low- and high-cost alternatives. The table shows a very important result. Under the high-cost alternative, we are able to save more brigade level manpower because we are reducing the inventory of tanks for the 1st Armor Training Brigade by 20 additional tanks. Simply having these tanks in the 1st Armor Training Brigade inventory requires significant levels of manpower. The 20 tanks are those additional tanks that TRADOC DCSRM authorized for the 1st Armor Training Brigade for FY 93. The manpower we save in the high-cost alternative is the level one and level two maintenance personnel. We do not save manpower for higher level (level three and four) maintenance because the tanks are transferred to excess capacity and still have level three and level four maintenance requirements. This brigade level savings in manpower does not necessarily translate into manpower savings for the Army. This manpower will not be reduced unless end-strength is reduced.

Table 5.34

Changes in Military Manpower for Both Low- and High-Cost Scenarios

Alternatives and Type of Manpower	Low-Cost Option	High-Cost Option
	Transfers to Other Organizations	Transfers to Other Organizations
• E-6: Tank commanders	13	2
• E-3: Level one maintenance	5	25
• E-4: Level two maintenance	4	22

There are some other important manpower considerations that result from this analysis. Manning for the 19K OSUT course is different from the AOAC course. A significant number of instructors are derived from the structure load calculation, and the results from this calculation are sensitive only to student input and course length (which is extended by two weeks in the structure load calculation). Table 5.35 highlights the workload factors that determine manning for the organizations involved in the 19K OSUT course. Our alternative affects a

number of the factors in Table 5.35—ICHs, number of tanks, estimated development man-hours, and unit maintenance standards. However, our alternative has not changed the basic structure of the companies or the brigade, or the student input. As a result, we cannot achieve any manpower savings for the training companies, platoons, drill instructors, or training group.

Table 5.35

Manpower Workload Factors

Group	Workload Factor
1st Armor Training Brigade	
• 2nd Battalion/13th Regiment	
—Tank commanders	ICHs
—Tank commander aides	Number of tanks
—Tank/turret maintenance	Unit maintenance standard
—Companies/drill instructors	Structure
—Platoons	Input/students per platoon
• POI committee	Estimated development man-hours
Training group	Course iterations
Weapons Department	ICHs
DOTD	Publications

There is another important comparison we need to make in this analysis: the difference between the basic portion and the advanced individual training (AIT) portion of the course. Our low-cost assumptions postulated that there were potential time savings with the substitution of CBT and TADSS. We were able to reduce the manpower required in the AIT (vehicle-specific) portion of the course through these time savings because the instructor contact hours changed. The basic portion of the course, which is resourced according to the structure load standard, is insensitive to potential time savings—unless the course is shortened. However, in the basic portion of the course we can gain some economies of scale in the development activity area. Our low-cost assumptions postulated that the costs for the basic portion development could be allocated across all basic and OSUT courses. As a result, the costs for this development and the savings in supplies and materiel associated with the basic events that were transformed to CBT instruction offer opportunities for savings. In the vehicle-specific portion, the CBT must be tailored to the specific course, and as a result, there are no opportunities for spreading the costs of development across other courses. In addition, the specialized nature of the CBT training for the AIT portion requires a greater number of CBT products that are also shorter in duration. For the alternative, this greater number of short segments of CBT increases the costs of development without a significant return. The use of CBT in the vehicle-specific portion requires much greater changes in content before there can be a return from using this method of instruction.

For both scenarios, the TADSS substitution provided the greater savings. However, the level of savings depends on the cost of the TADSS and the implementation. We substituted TADSS for those training events in the AIT portion that did not require the entire tank for training. There could be even greater savings if we substituted the TADSS for additional training events that currently require the on-tank training.

Sizing the Savings. In order to place our alternatives in perspective, we need a benchmark for the decision maker. In the case of the 19K OSUT course, we chose the operating budget for the 1st Armor Training Brigade. The FY 95 budget for the 1st Armor Training Brigade is estimated to be $3.2 million. Our low-cost alternative will save $1.2 million (in fuel and spares) for the 1st Armor Training Brigade. Figure 5.4 illustrates the slice of the FY 95 1st Armor Training Brigade operating budget that will be reduced as a result of implementing the low-cost TADSS alternative.

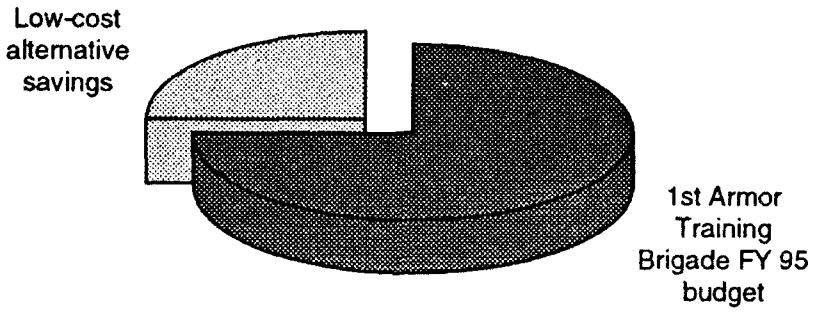


Figure 5.4—Low-Cost Alternative's Savings Slice of the Budget Pie

Figure 5.5 highlights the high-cost alternative's savings slice of the 1st Armor Training Brigade's FY 95 budget. As the figure illustrates, the savings are smaller. However, these savings are still significant.[30]

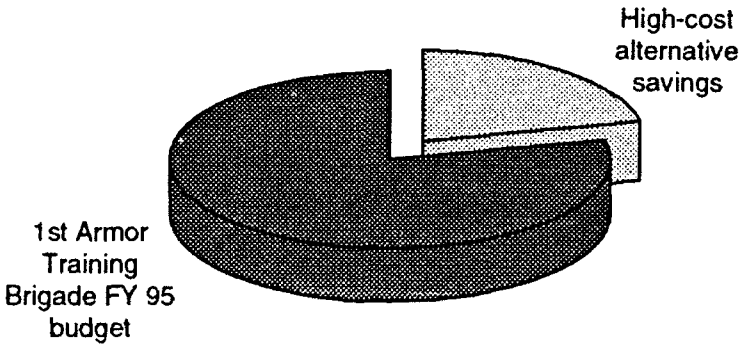


Figure 5.5—High-Cost Alternative's Savings Slice of the Budget Pie

Tradeoffs. There are a number of areas of uncertainty involved with our TADSS alternative. We do not know how the simulators compare to tanks in terms of training effectiveness. Nor do we know the differences in proficiency or skill decay between training on simulators and training on tanks. Further, we do not know field commanders' confidence in the simulator training. Finally, we do not know the exact procurement or operating and support costs

[30]Appendix C contains additional details concerning the savings generated under the high-cost scenario.

for our proposed TADSS. However, it is likely that the true costs lie between the two alternative implementations. These qualitative issues also need to be considered by the decision maker when evaluating the alternatives presented in our analysis.

Bottom Line. The TADSS strategy can offer potential savings in operating costs of the M1/M1A1 tanks. However, a key factor in the amount of savings is the actual implementation of the alternative. Our detailed application of TRAM demonstrated that the timing and ways in which the alternatives are implemented can make a significant difference in costs and savings and that the factors of time and implementation need to be part of an analysis of a favored alternative.

The application of TRAM in the 19K analysis highlighted some important considerations for using CBT as an instructional strategy. CBT can offer some time savings and economies of scale for the basic portion of the course. However, for CBT to be effective for the AIT portion of the course, greater changes need to be made in the content of the events that use CBT. Another important finding in our analysis is the need for TADSS to be identified early enough to be incorporated into the planning cycle and when and how the TADSS are integrated into the course.

While the TADSS strategy offers savings in operating and support costs of the tanks, TRAM and its detailed approach have identified other opportunities for further savings. These involve reconsideration of the basic resourcing factors that are used in the course. The structure load factor extends the course by two weeks, which has the effect of adding significant manpower. At a minimum, the Army should reconsider whether a full two weeks is required for course turn-around purposes. In addition, the resourcing standard for the training group is based on the number of course iterations, and manning for this group is extremely high compared to the amount of actual instruction they provide for the course. Training group manning changes occur only when the number of course iterations declines. However, there are other factors that are important in determining the workload of this group that are not captured by the current standard. The tank resourcing process is based on tank days and an arbitrary 25 percent additive that is designed to cover set-up and tear-down time. The basic inventory of tanks drives costs, and the Army should provide better analytic foundations for the additive.

6. CONCLUSIONS

The TRAM approach to costing alternative training strategies emphasizes thorough definition of the training alternatives and a structured examination of the *changes* in activities and resources through the use of a balance sheet. This is very useful in analyzing training alternatives, because without such a structured approach, important resource changes—including indirect effects—may be omitted and critical assumptions may remain unexplored. These omissions result in cost conclusions that are unrealistic and contribute little to informed training decisions.

TRAM improves decision making by linking costs to the specific alternatives being evaluated. By completely documenting and qualifying the cost results, TRAM helps ensure that appropriate conclusions about the costs of decisions are made. By providing this linkage between costs and training decisions, TRAM facilitates identification and investigation of cost tradeoffs and makes it possible to ask "what if" questions. TRAM also allows the opportunity to uncover new alternatives. Areas of uncertainty highlighted in the process may be examined, and assumptions about the implementation of an alternative may lead to the creation of additional options that suggest alternative implementations.

TRAM can provide important insights at each of its steps. For example, in the definition step, we found that an alternative can be specified in more than just one way—depending on the assumptions that are employed concerning implementation of that alternative. This is important because the Army has considered a very limited number of implementations of broadly defined strategies—such as distributed training.[1]

In the activity analysis, we found that most of the various systems do not track activities, resources, and costs on a course basis. The courses and their attendant resources drive the costs for the school, and in this period of budget reductions and cost cutting there is increasingly a need to analyze individual course costs simply because decisions concerning instructional methods, course length, and class size have critical cost consequences.

The activity analysis and resource analysis steps highlighted the importance of the support functions as major activity areas and consumers of resources. However, we found that many of the relationships between changes in support workload and required resources are not complete or are not adequately defined. Until these relationships are better defined, it is difficult to quantify how changes in training affect these functions, and it is difficult to identify opportunities for greater efficiencies.

The resource analysis step also uncovered problems with some of the resourcing standards. We found some critical resourcing standards that need to be developed, updated, and reassessed. The resourcing standards are the heart of the resourcing process and need to be scrutinized for their underlying assumptions, accuracy, and timeliness. Adequate standards do not exist for many support functions. In the case of training development, we had to use old manning factors and develop an alternative standard of our own. Standards are cur-

[1]The implementations considered by the Army also have crucial assumptions embedded in them—such as the capacity of the field units.

rently being updated for developers. However, in investigating the standards for training developers, we found that there are some opportunities for the elimination of duplicate development efforts between training development personnel and subject matter experts within the training delivery departments. For instructors, TRAS code student:instructor ratios are currently predetermined. These ratios may not be appropriate in all cases and should be reviewed. If student:instructor ratios can be increased without serious training degradation (which is one of the benefits of learning technologies such as computer-based training), there are significant opportunities for manpower savings.

When developing the cost models for the alternatives, we found that resources frequently have more than one cost factor. For example, the Armor School sometimes uses fuel and spare parts cost factors provided by the Army Modernization Information Memorandum. At other times, the school uses factors provided by the Army Maintenance Management Systems Equipment Data Base (TAMMS-EDB) or the Operations and Support Management Information System (OSMIS). We found that the cost analysts and decision makers want to compare the results using alternative cost factors. As a result, we structured the method to provide the flexibility to use different cost values. However, it is important that factors are used consistently and that analysts know which factors to use.

There are three important conclusions that we reached in the final step of the method—placing the costs in context. First, by simply listing the activity and resource changes, the decision maker can see what he is trading for the savings. Second, a significant portion of training resources are devoted to training support and base operations functions that are insensitive to course reductions and changes in instructional methods. Without other major changes in training, such as consolidating occupational specialties, facilities, and installations, savings in training costs may be at the margin. And third, while it may be true that some savings accrue by distributing training to the units, there is a point of maximum absorption for the field units. At this point of maximum absorption, investment requirements for distributed training infrastructure support will increase significantly.

TRAM is a first step in analyzing cost behavior of training activities. By employing TRAM, we have identified some important structural determinants of training costs—such as resourcing policies and formulas, patterns of resource utilization, and relationships among activities. However, we need to broaden the scope of this costing method and further identify and analyze other determinants of training costs, which include more training organizations and additional Army discretionary policies, such as the mix and variety of courses at training installations.

Appendix A
INDIVIDUAL TRAINING RESOURCE AND COST FACTORS

The training resource analysis method is built on the premise that the activity changes and associated resource implications of any given training change will drive the cost of that change. The activity analysis portion of the method analyzes in detail the impact of the training change on training delivery, development, and support. All types of training activities are subsumed under these three areas.

In this section, we describe general sources of information on resource and cost factors that may be used in determining the impact of changes in training. We list sources for the level and type of resources and costs. We also discuss some issues related to Army cost factors.

ACTIVITY LEVELS

At the course level, there are some basic "drivers" of activity levels: student input, course length, class size, and instructional methods. Each driver affects the three major activity areas. Understanding the interdependencies of the effects of these drivers is important in determining the overall resource implications for a change in training. For delivery, the student input and class size determine how many iterations of the course will be given during a fiscal year. Changes in either of these variables may result in a change in the number of times a course is offered. This, in turn, affects the number of instructors required for the course. Support activities are also affected by student input and class size. Student input affects such support areas as housing and supply. Class size affects the support areas of scheduling and facilities and equipment maintenance. Instructional methods may affect all three activity areas. Instructional methods are part of many of the resourcing equations that determine the number of instructors. Decisions concerning instructional methods affect the quantities and the types of instructional products that must be produced. The maintenance levels of the equipment, the quantity of ammunition, and facilities that serve these methods may also be affected.

A key source for required activity levels is the course's most recent Program of Instruction (POI). The POI designates length of course, class size (minimum, optimal, and maximum), total instructor contact hours, methods of instruction, equipment, supplies, training aids/devices/simulators, and facilities. The source for individual event contact hours is the ICH computation worksheet. This listing of ICHs for the course designates the ICHs for each department involved in instructing the course.

Not all the resources that are listed in the POI may be authorized for a given fiscal year. Some activities listed in the POI may be omitted. As a result, the individual instructional departments and the installation's DRM offices are key sources for information concerning authorized resources. TRAM uses authorizations rather than requirements or actuals because authorizations are reflected in the Army budgets.

RESOURCE FACTORS

Changes in activities generate changes in resource requirements. Important resource factors in training decisions can be grouped under six major headings:

1. Changes in manning quantity.
2. Changes in manning type.
3. Changes in equipment quantity.
4. Changes in equipment type.
5. Changes in facility quantity.
6. Changes in facility type.

Manning type resource changes apply to a multitude of personnel characteristics including skill, rank, grade, and occupation. Changes in equipment include weapons, major end-items, materiel, and supplies. Facilities changes refer to any characteristics of facilities that affect cost.

Manpower

Manpower Quantity. By TRADOC's own accounting for the fiscal years of 1988 through 1991, manpower costs alone accounted for between 50 percent and 60 percent of the budget. This includes military pay and benefits covered by Military Personnel appropriation and civilian personnel covered under the Operations and Maintenance appropriation.[1]

Manpower levels are listed in the Tables of Distribution and Allowances (TDA) for the various organizations at the school. These organizations are categorized according to Unit Identifying Codes (UIC). Within the TDA are paragraph numbers that identify subunits. For example, the TDA for the training departments at the Armor School has paragraph numbers that identify the training department—Weapons, Command and Staff, and Maintenance. The TDA also lists the Army Management Structure Code (AMSCO) for each paragraph number. The TDA for the UIC will list both required and authorized quantities of positions for the organization.

A key source for current and forecasted student input is the Army Training Requirements and Resources System (ATRRS). ATRRS contains information on the course level and shows the sources of students (e.g., reserve/active and branch) as well as their number. The Requirements Based Course List (RBCL) summarizes, by course, key POI data such as course length in weeks, optimal class size, and ICHs. It also includes student input and average load. The report calculates the instructor requirements for each course. This report is updated for the Structure/Manning Decision Review (SMDR) and the Training Requirements Management (TRM) and includes major changes in anticipated student load.

Manpower Type. The TDAs also list specific position title, grade, and branch for all personnel assigned to the UIC.

[1]These estimates come from data collected by TRADOC's Planning, Programming, Analysis, and Evaluation Directorate.

Manpower Changes. The TRAM approach focuses on changes in resources that are generated by an alternative. In order to calculate changes in manpower resources, the method examines the specific activity or workload changes and translates these changes into changes in resources. For example, in order to calculate changes in instructors for the AOAC course, the method identifies the change in instructor contact hours and then applies the appropriate Manpower Staffing Standards System (MS3) formula to determine the change in the number of instructors. The ICH computation worksheets provide the baseline ICHs. We determine the new ICHs using the Training Requirements Analysis System (TRAS), TRADOC Regulation 351-1. TRAS provides the appropriate instructor-to-student ratios.

TRAM uses the variable portion of the MS3 formulas to determine the changes. For example, for the AOAC course, the MS3 instructor formula is 66.62 + 1.54 * (monthly instructor contact hours)/145. The fixed manpower portion of the formula, 66.62, is the basic requirement to open the doors. The 1.54 variable portion of the formula is the amount of time an instructor needs for each monthly contact hour. The 145 is the monthly manpower availability factor. To calculate the change in instructors, we take the change in monthly instructor contact hours, multiply by the variable factor, and divide by 145.

There are many different MS3 formulas for the various functions in the schools. And not all instructors are resourced according to ICHs. The staffing formula for these instructors may be based on overall student input and the size of training platoons. The Deputy Chief of Staff for Resource Management's Force Management Directorate maintains a listing of the applicable standards for all the TRADOC schools. This listing includes delivery, development, and some support formulas.

Manpower for training developers is determined by the number of products that must be developed and maintained. The resourcing basis for training developers is currently estimated time values.[2] We use the *Workload Categories for Training Development Processes and Products,* dated January 1987, to determine the changes in training developer manpower.[3] This document was published by the TRADOC Management and Engineering Activity (TRAMEA) and lists the time values required for the large variety of training products that are produced.[4]

MS3 standards for Fort Knox exist for the following:

- Basic Training Group
- Basic Training Structure
- Civilian Personnel Office
- Fire Protection
- Instructors
- Instructor additives (including level one maintenance)

[2]As already mentioned, this standard is being updated.

[3]U.S. Army Training and Doctrine Command (TRADOC), Deputy Chief of Staff for Resource Management, *Workload Categories for Training Development Processes and Products*, Fort Monroe, Va., January 1987.

[4]For the AOAC course, we developed an alternative approach to determining the cost of development, and this is explained in Appendix A's discussion of cost factors for training products.

- Maintenance Standards
- Military Personnel
- NCO Academy
- Proponency Office
- Procurement
- Reception Station
- Office of Safety
- School Secretary
- Training Department Management
- Training Development
- General Training Management

For those functions that do not have MS3 standards, we use the Staffing Guides for TRADOC.[5] The staffing guides include manpower yardsticks that indicate the manpower requirements based on workload for various organizational groupings of functions. The staffing guides also provide the following for both military and civilian personnel: appropriate position title, military occupational specialty, and grades of positions. The guides also include numerical distribution of positions by type at each work center level.

Equipment/Materiel/Supplies

Equipment/Materiel/Supply Levels. The TDAs provide information on equipment. The TDAs list the required and authorized equipment by line item number (LIN). In addition each school function maintains a listing of its authorized equipment.

Another important source of information concerning equipment and materiel levels is the Total Army Equipment Distribution Program (TAEDP). The TAEDP provides the specifics of equipment distribution (both quantities and timing) at the UIC level. The TAEDP includes both initial issue quantities and replacement equipment. The TAEDP files project inventories through the POM years and identify organizations which will receive modernization equipment.

The POI also lists specific equipment with equipment-student ratios. The POI provides information on the amount of ammunition used in the course and training aids/devices/simulators.

A key aspect of equipment is levels of operating rates. A source of target operating rates is the Army Modernization Information Memorandum (AMIM). The Operations and Support Management Information System (OSMIS) reports operating miles or hours for major items of equipment. The Army Maintenance Management Systems Equipment Data Base

[5]Department of the Army, *Staffing Guide for U.S. Army Training Centers*, Pamphlet 570-555, Washington, D.C., 1985; Department of the Army, *Staffing Guide for U.S. Army Service Schools*, Pamphlet 570-558, Washington, D.C., 1983. We also use the guides for school functions when the school's DRM function used the staffing guides rather than the current MS3 standards for support functions.

(TAMMS-EDB) covers ground equipment and reports mileage and some overhaul data. In addition, the Quarterly Equipment Usage Report maintained at each school lists the current usage levels of equipment.[6]

Equipment/Materiel/Supply Types. The TDA for organizational units includes the type of equipment and the required and authorized amounts of equipment. The POI lists the type of equipment used in the course and the listing is matched to the event using the equipment/materiel/supplies. The work centers at the schools also maintain a listing of the types and quantity of equipment used.

Equipment/Materiel/Supply Changes. The Army has been fielding a system to aid unit commanders in managing their resources. The Battalion Level Training Model (BLTM) captures information concerning major end-item usage and ammunition. The BLTM covers about 15 items of equipment that have operating rates measured in miles and another 15 items of equipment that have operating rates measured in hours. The BLTM can be used as an initial estimate of changes in operating rates for these equipment items that are generated by changes in the POI.

In identifying the need for new items of equipment, we simply review the existing TDAs and determine if the equipment exists. If the equipment does not exist as part of the TDA, we then refer to the Army Master Data File (AMDF) or the Supply Bulletin 700-20, which are the most comprehensive sources of data on current equipment and materiel prices. If the equipment does exist in the TDA, we then determine if there is a surplus or deficit based on the new usage requirements.

The Training Ammunition Management System (TAMIS) tracks required, authorized, and actually expended ammunition and small missiles. TAMIS tracks ammunition by UIC code. If there is a change in ammunition use as a result of changing the course, both the POI and TAMIS supply information concerning ammunition.

Facilities

Facilities Levels. The TRADOC *Installation Guide*[7] provides general information on the organizations and units housed at each TRADOC location. It also provides information on the civilian population supported, real property, facilities (with square footage), ranges, and other training assets. The ATRM-2 Report provides information on the population and

[6]This report is no longer required. It was a valuable source of information concerning maintenance days and availability of equipment.

[7]U.S. Army Training and Doctrine Command (TRADOC), Deputy Chief of Staff for Resource Management, *Installation Guide*, Pamphlet 210-1, Fort Monroe, Va., 1988.

square footage of the installation. The ATRM-2 allocates facility usage based on population. The ATRM-2 is also incorporated into the ATRM 836-R Report, which lists the number of military and civilians by man-year. This report also allocates the maintenance account BASOPS.C. This covers installation based intermediate maintenance.[8]

Facilities Types. The POI lists the specific facilities that are used by the course, which include classrooms, lecture halls, ranges, and maintenance facilities.

Facilities Changes. The Army Corps of Engineers provides a Facilities Planning System (FPS), which uses personnel and equipment as a basis for determining facilities square footage requirements. This system can be used to determine when new facilities are required based on changes in equipment and manning.

At the installation, the Directorate of Engineering and Housing tracks the facilities and the Directorate of Plans, Training, and Mobilization (DPTM) schedules the use of the facilities. DPTM can provide historical information concerning the relationship between changes in student loads and facilities' usage.

COST FACTORS, SOURCES, AND ISSUES

The TRAM method is a detailed approach to estimating the costs of decisions involved in training changes. The method estimates both the direct and indirect costs of a training decision. As a result, the method uses a wide variety of cost information. Table A.1 lists the general cost areas and some major sources of cost information for these areas. We define these sources in each paragraph detailing the specific cost factors.

The Army is currently in the midst of revitalizing its cost efforts. It is developing a wide variety of databases and models. However, until these models are completed, there are a number of competing sources of cost information. The costing effort will require an examination of these cost information sources and an assessment of the applicability of the cost values to each decision.

Specific types of training changes may have several different costs under each category. For example, under the category Nonrecurring/Civilian Personnel Costs/Acquisition there may be several different types of civilian personnel that need to be recruited, hired, and trained. The calculation of each of these factors may involve changes in more than one of the resource factors.

[8]We do not use this account because the population base is used to allocate maintenance. The more appropriate allocation factor for this maintenance is materiel and operating levels.

Table A.1

General Training Cost Factors and Sources

	Source	Source	Source
NONRECURRING COSTS			
Civilian personnel cost			
• Acquisition	CPO	DCSPER	RFH
• Initial training	CPO		
• Separation	RFH		
• Transfer	RFH		
Military personnel cost			
• Initial training	DRM	departments	
• Transfer	JFTR	DAPE-MBB	
New training products	time values	surveys	
Equipment procurement	AMDF	SB 700-20	DCSLOG POM Procurement Data Base
Equipment transfer	Traffic Management	CEAC	TAFCS
Initial spares/stock	DRM	OSMIS	
Construction/remodels	AR 415-17	R-PLANS	
RECURRING COSTS			
Civilian personnel cost			
• Replacement acquisition	CPO		
• Replacement training	CPO		
• Pay	Uniformed Services Almanac	Federal Personnel Guide	Federal Wage System
• Allowances	RFH		
Military personnel cost			
• Replacement training	work centers		
• Student PCS	JFTR	DAPE-MBB	entitlements
• Student TDY	Accounting Division		
• Instructor TDY	Accounting Division		
Training product maintenance	time values	surveys	
Fuel, oil, etc. (POL)	DCSLOG PB		
Replenishment spares	OSMIS		
Ammunition	AMCCOM	TAMIS	AMDF
Equipment maintenance	OSMIS		
Training product distribution	Traffic Management	DPTM	
Product reproduction	BMG		
Facility maintenance	BOPM		
OTHER			
Inflation factors	OSD	CEAC	

NOTE: Traffic Management stands for Traffic Management's Quarterly Report. OSD stands for Office of Secretary of Defense. Other acronyms are defined in the section explaining those cost factors.

Table A.2 serves as a general model and the Xs in the cells designate which resource factors may be involved in the calculation of cost.

Table A.2

General Cost Model

Costs	Resource Factors						
		Manning		Equipment		Facilities	
	Activity Level	Amount	Type	Amount	Type	Amount	Type
NONRECURRING COSTS							
Civilian personnel cost							
• Acquisition	X	X	X			X	X
• Initial training	X	X	X			X	X
• Separation	X	X	X			X	X
• Transfer	X	X	X			X	X
Military personnel cost							
• Initial training	X	X	X			X	X
• Transfer	X	X	X			X	X
New training products				X	X	X	X
Equipment procurement	X			X	X	X	X
Equipment transfer	X			X	X	X	X
Initial spares/stock	X			X	X		
Construction remodels	X	X	X	X	X	X	X
RECURRING COSTS							
Civilian personnel cost							
• Replacement acquisition		X	X			X	X
• Replacement training		X	X			X	X
• Pay	X	X	X			X	X
• Allowances	X	X	X			X	X
Military personnel cost							
• Replacement training		X	X			X	X
• Student PCS	X	X	X			X	X
• Student TDY	X	X	X			X	X
• Instructor TDY	X	X	X			X	X
Training product maintenance	X			X		X	X
				X			
Fuel, oil, etc. (POL)	X			X	X		
Replenishment spares	X			X	X		
Ammunition		X	X	X	X		
Equipment maintenance	X			X	X		
Product distribution		X	X	X	X		
Product reproduction		X	X	X	X		
Facility maintenance	X	X	X	X	X	X	X
OTHER							
Inflation factors		X	X	X	X	X	X

The particulars of the training change will dictate which resource changes need to be considered. Table A.2 serves as a planning tool for considering which resource changes to include in the cost factor calculations.

Nonrecurring Costs

Civilian Personnel Acquisition Costs. The costs of civilian personnel acquisition include advertising, recruiters' time and travel, placement costs, relocation costs, and travel of recruits. Recruiting and placement costs vary by type of civilian position. The actual manage-

ment of civilian personnel is decentralized to the installations. Installation manpower analysts in the Directorate of Resource Management (DRM) offices establish the civilian requirements based on workload and use either the MS3 standards or the staffing guides to determine the required number of positions. There also may be civilian contractors who provide services. The best source of information concerning the costs of these contractors is the installation's Directorate of Contracting.[9]

The installation Civilian Personnel Offices (CPOs) are the best source for information concerning the cost of recruitment and placement of specific grades of civilian personnel. The Office of the Deputy Chief of Staff for Personnel (DCSPER) provides cost factors for civilian personnel. In addition, the TRADOC *Resource Factor Handbook* (RFH)[10] includes rates for permanent change of station for civilian employees. The handbook also advises the cost analyst how to estimate civilian personnel costs if more detailed information is not available.

The estimating equation for the nonrecurring costs of acquiring additional civilian personnel is:

(summed over all types of affected civilian personnel)
(number of civilian personnel/grade) * (aquisition cost/civilian/grade)

Civilian Personnel Initial Training Costs. The costs of civilian personnel initial training include any formal courses, travel to those courses, and time devoted to orientation. Initial training costs vary by type of civilian position.

The installation CPOs are the best source for information concerning the cost of initial training and orientation of specific grades of civilian personnel. Also, the staff and faculty departments within the installation's Directorate of Training and Doctrine can provide information on the costs of staff training. In addition, TRADOC provides estimates of costs of civilian training courses. However, these estimates are derived from the CERs and MERs.

The estimating equation for the nonrecurring costs of initial training for additional civilian personnel is:

(summed over all types of affected personnel)
(number of civilian personnel/grade) * (initial training cost/civilian/grade)

Civilian Separation Costs. A career civilian employee who is separated through a reduction in force is entitled to retirement or severance pay (but not both). Employees who meet certain combination age and service requirements can retire on an immediate annuity without any reduction due to age. A civilian employee who is not eligible for an annuity is entitled to a maximum severance pay of one year's salary. An employee receives a week's salary for each year of the first 10 years of service; two week's salary for each year of service after 10 years, and an age adjustment allowance of 10 percent of the total basic severance allowance for each year by which the employee's age exceeds 40. In addition, separated employees may receive up to 30 days of accumulated leave pay.

[9]In addition, the maintenance division retains information on civilian maintenance contractors.

[10]The *Resource Factor Handbook* was published in two volumes prior to 1991. The 1991 version is a consolidation of both the resource estimating relationships and the factors for pay, benefits, and PCS.

The TRADOC *Resource Factor Handbook* provides information on how to estimate the costs of civilian separations if detailed information concerning specific grades and length of service is not available.

The estimating equation for civilian personnel separations is:

(summed over all types of affected personnel)
Lump sum payment/separation: (hourly rate/grade * 240 hours)
Severance Pay: [(weekly pay/grade * 10) + [(2 * weekly pay/grade (if >10)]
* (.1 * number of years > age 40)]

Civilian Personnel Transfer. Civilian personnel may be transferred due to changes in training. Civilian relocation costs depend on the details of the training change. However, these costs can be significant and need to be considered in estimating the potential impact of a training change.

The TRADOC *Resource Factor Handbook* outlines the costs involved in a civilian permanent change of station (PCS). There are five major components of a civilian PCS: travel to seek residence, sale and purchase of home, movement of household goods, PCS travel, and tempo rary quarters allowance.

The estimating equation for a civilian PCS is:

(travel mileage * mileage rate) + (per diem * number of days)
+ (sale of home price * eligible percentage rate)
+ (new house price * eligible percentage rate)
+ (movement of household—65 percent of officer operational PCS move)
+ (PCS travel miles * number of miles)
+ (temporary quarters allowance)

Military Personnel Initial Training Cost. The costs of a training change may include nonrecurring costs for the training of military personnel for new positions. These costs will vary by position, rank, and officer or enlisted status. Initial training costs may include formal course costs, student travel, and general orientation time.

The estimating equation for military initial training is:

(summed over all types of affected personnel)
(number of military in new position) * (training cost for type of position)

Military Transfer Costs. There are several circumstances where military transfers may be part of a training change. For example, military instructors who are identified as surplus as a result of a reduction in the length of a course may be transferred. In addition, there may be excess military support personnel who need to be transferred to other locations.

When the grade of the position can be identified, cost estimates can be based on the provisions of the Joint Federal Travel Regulations (JFTR). The sum of the travel allowance, the household goods shipments, and the dislocation allowance for each military grade times the number in each grade is the estimated transfer cost. The Deputy Chief of Staff for Personnel (DAPE-MBB) provides the average cost factors for PCS moves shown in Table A.3.

Table A.3

Military Permanent Change of Station Factors FY 91

Type of Move	Officer	Enlisted
Accession	$ 3,467	$ 923
Operational	$ 7,932	$2,826
Training	$ 7,867	$2,038
Separation	$ 3,132	$1,088
Rotational	$12,426	$3,989
Unit	$ 8,090	$2,058

The estimating equation for military transfers is:

(summed over all types of affected personnel)
(number of transfers/type) * (cost of transfer type of PCS move)

New Training Product Costs. Estimated time values are currently used to determine the manpower required for developing new training products. Equipment/materiel and supply costs for this function can be determined by examining the installation's Budget Manpower Guidance (BMG). The BMG shows these costs by element of expense. However, there is concern within TRADOC's Deputy Chief of Staff for Training and the Deputy Chief of Staff for Resource Management that the estimated time values are not accurate. In order to address this concern, we conducted a small survey of major producers of training products. The focus of this survey was to generally determine the development cost and sustainment cost per hour of major types of instruction. We used the content of the AOAC course and the particular events that would be using alternative training products to place general boundaries on the material that needed to be taught using these technologies.

Included in our survey were commercial firms such as Xerox, IBM, Price Waterhouse, and Arthur Andersen. We also surveyed educational institutions such as UCLA, Cornell, and the University of Massachusetts, educational institutions that are extensively involved in developing educational technology. Other sources of information on the cost of training development were associations and government. We contacted the American Association for Artificial Intelligence and three Army offices—the Army Research Institute, TRADOC's Army Training Support Center, and TRADOC Analysis Command. As expected, we obtained a wide range of costs for the development and sustainment of the following training products:

- Paper-based instruction
- Televideo-based instruction
- Computer-aided instruction
- Interactive video disk
- Simulations
- Demonstration-based instruction

We used the median values obtained from this survey for the cost of training products. The nonrecurring cost of development for each of these products is shown in Table A.4. These

costs include the manpower, equipment, materiel, and supply costs for each hour of product training.

Table A.4

Nonrecurring Development Costs of Training Products

Product	Per Hour Development Cost
Paper-based	$ 7,000
Televideo	$40,000
Computer-aided: Interactive	$12,000
Computer-aided: Tutorial/Modifications*	$ 8,000
Interactive video disk: Interaction	$20,000
Interactive video disk: Simulation	$40,000
Demonstration	$ 7,000

NOTE: *Computer-aided tutorials/modifications designate typical tutorial types of programs and modification/tailoring of off-the-shelf existing programs.

These are the costs we use for estimating the high cost of initial training development. While the existing time values are based on a total training product, these values are an hourly rate.

Equipment Procurement. The cost for equipment procurement is greatly dependent on the training decision under consideration. For items such as computers, the cost can easily be obtained from existing data sources such as the Army Master Data File (AMDF) or the various supply bulletins. However, for new items such as simulators that do not currently exist, additional costs such as maintenance support and initial spares may need to be included in the cost.[11] Costs for equipment are dependent upon whether the equipment is available from existing inventories—not all equipment will have to be procured.

The most comprehensive listing of costs for Class VI (end-items), Class VII (medical), and Class IX (spares and repair parts) is the AMDF. AMDF prices are those charged by the Army stock fund for stock-funded items or the latest procurement price for nonstock-funded items. Another source of prices is the Supply Bulletin 700-20 (SB 700-20). This bulletin lists prices by LIN. A source for estimated prices of new equipment is the LIN price file maintained by Deputy Chief of Staff for Logistics (DCSLOG). It uses prices from the POM (Program Objective Management) Procurement Data Base and Supply Bulletin 700-20.

The general estimating equation for new equipment is:

(summed over all types of new equipment required by the decision)
(equipment type) * (quantity required) * (price)

Equipment Transfer. Equipment transfer costs fall in one of two categories. First, there is the transport of equipment from their point of origin to an Army delivery point. This is called "first destination" transport. Second, there is the transport of equipment from one Army lo-

[11]Also, for new training devices, there frequently are no cost factors. In this case, analogous systems may be used as a benchmark with high and low estimates of parallel costs.

cation to another—including movement between installations, units, and depot maintenance sites.

First destination transport is usually covered in the acquisition cost and is often included in the procurement prices reported in the AMDF database. The *Resource Factor Handbook* contains typical transport cost rates (average costs per ton-mile for air, motor, and rail). The handbook also includes transport rates for vehicles and parts.[12] A more detailed listing of transport rates is included in the DOD Military Traffic Management Command's Quarterly Progress Report.

To avoid "double counting" the analyst needs to determine if transport costs are included in the prices provided for initial equipment procurement. The estimating equation for transport of equipment is:

(summed over all types of affected equipment)
(cost of transport of equipment type) * (quantity of equipment type)

Initial Spares/Stock. Often associated with new equipment is the need for initial repair parts and components. This initial provisioning is estimated in many different ways. A common rule of thumb is to allow up to 30 percent of the equipment's cost to initial provisioning for spares and repair parts. Higher percentages are allowed for equipment that has high operating rates and tends to require more parts. Sometimes analogous systems are used to determine the initial requirements.

The costs of initial spares and stock are greatly dependent on the actual equipment and circumstances involved in the training change. There is no general equation that can be used for this factor.

Construction/Remodels. The Army Corps of Engineers annually computes dollars-per-square-foot cost factors based on the type of facility The corps derives these costs from contract bid experience. These costs are supplied by a newsletter issued by the Corps of Engineers.[13] The dollar value for each type of facility is shown as a mean factor, and supplemented by a regional index. Army Regulation 415-17 (AR 415-17) provides separate figures for adjusting the cost estimate based on building sizes that are different from the ones assumed in the cost factor tables issued by the corps.[14]

Added to the costs of construction are two other factors. One is a 6 percent adjustment to reflect estimated project costs for supervision and administration. The second one is a 5.5 percent adjustment for contingencies. In the future, these calculations will be done by the Real Property and Analysis System (R-PLANS). R-PLANS will compare desired facilities against existing facility availability and will compute the new construction requirements.

The equation for new construction or remodels is:

[12]The most recent *Resource Factor Handbook* does not include these cost factors. There are plans to include these costs in The Army Force Cost System (TAFCS), which is being developed by the Army Cost and Economic Analysis Center (CEAC).

[13]The newletter also reports construction inflation factors provided by the Secretary of Defense.

[14]Department of the Army, *Cost Estimating for Military Programming*, AR 415-17, Washington, D.C., February 15, 1980.

(summed over all types of facilities)
(square foot changes) * [(cost per square foot for type of facility * (administration and contingency factors)]

Recurring Costs

Civilian Personnel Replacement Acquisition Cost. The costs of civilian personnel replacement acquisition include advertising, recruiters' time and travel, placement costs, relocation costs, and travel of recruits. Replacement acquisition costs vary by type of civilian position. The installation Civilian Personnel Offices (CPOs) are the best source for information concerning the turnover rates of specific grades of civilian personnel.

The estimating equation for the recurring costs of replacing civilian personnel is:

(summed over all types of affected personnel)
(number of civilian personnel/grade) * (aquisition cost/civilian/grade) * (civilian personnel/grade turnover)

Civilian Personnel Replacement Training. The costs of civilian personnel replacement training include any formal courses, travel to those courses, and time devoted to orientation. The replacement training costs vary by type of civilian position.

The installation CPOs are the best source for information concerning the cost of replacement training and orientation of specific grades of civilian personnel.

The estimating equation for the recurring costs of initial training for additional civilian personnel is:

(summed over all types of affected personnel)
(number of civilian personnel/grade) * (replacement training cost/civilian/grade) * (turnover of civilian personnel/grade)

Civilian Pay. Civilian personnel receive pay according to government pay scales at statutory rates. Total direct compensation may include: base pay, merit pay, overtime pay, holiday pay, and hazardous duty pay. Civilian base pay varies by pay grade and years within the pay grade. The *Uniformed Services Almanac*[15] and the Federal Personnel Guide provide tables for calculating civilian base pay. The Federal Wage System for blue-collar employees is based on local prevailing wage rates, and the wage scales are available at the installations from the manpower section of the DRM office.

The estimating equation for civilian employees base pay is:

(summed over all affected civilian personnel)
(pay per grade per year) * (number of affected civilian personnel/grade)

[15]L. E. Sharff, ed., *Uniformed Services Almanac*, Washington, D.C.: Uniformed Services Almanac, Inc., January 1991.

Civilian Benefits. In addition to direct compensation, civilians receive indirect benefits in the form of government contributions to employee health, life, and disability insurance. For TRADOC employees, pay and benefits are principally in the Operations and Maintenance appropriation.

Benefit factors are provided in the *Resource Factor Handbook.* The factors in this source represent the composite benefit rates for General Schedule Personnel and Wage Board Personnel.

The estimating equation for benefits based on a training decision involving man-years is:

(summed over all affected personnel)
(annual salary cost/grade) * (1.3514)[16]

Military Personnel Replacement Training. The costs of military personnel replacement training include any formal courses, travel to those courses, and time devoted to orientation. The replacement training costs vary by type of military position.

The installation work centers are the best source for information concerning the turnover rates and costs of replacement training and orientation of specific grades of military personnel.

The estimating equation for the recurring costs of initial training for additional military personnel is:

(summed over all types of affected personnel)
(number of military personnel/grade) * (replacement training cost/grade) * (turnover of military personnel/grade)

Student Permanent Change of Station Costs. Courses that are 20 weeks or longer in duration qualify as permanent change of station moves. The cost estimates for these student relocations can be based on the provisions of the Joint Federal Travel Regulations (JFTR) because the grade of the student is readily identifiable. The sum of the travel allowance, the household goods shipments, and the dislocation allowance for each military grade times the number in each grade is the estimated transfer cost. For a permanent change of station, the travel portion of the cost is included in the move. The Deputy Chief of Staff for Personnel (DAPE-MBB) provides the average cost factors for PCS student moves shown in Table A.5.

Table A.5

Military Training Permanent Change of Station Factors FY 91

Type of Move	Officer	Enlisted
Training	$7,867	$2,038

[16]This figure includes both funded and unfunded benefits. According to Army guidance provided in the *Resource Factor Handbook*, unfunded benefits should be included in training decision costs.

In addition, DCSPER also provides more detailed information in its Entitlements Section concerning specific rates by officer and enlisted grades. We found that the calculation of the average rates and the specific rates often lagged by as long as a year. As a result, we applied inflation factors provided by the Department of the Army.[17]

The estimating equation for student PCS is:

(number of transfers/student type—officer or enlisted) * (cost of PCS move)

Student Temporary Duty Costs. Students sent to attend courses at TRADOC installations that are less than 20 weeks in duration receive transportation and per diem. The per diem rate will vary based on the location of the installation and whether meals, quarters, or both are available. The availability of quarters and meals is an important aspect of the cost calculation for student TDY.

The travel cost will vary depending on whether the student is enroute to another assignment or will be returning to his unit. The reasons the travel cost will vary in our TRAM method is because if the soldier is TDY enroute, the cost of his travel would be incurred regardless because he is moving to a new position or unit. The method includes only one segment of the travel—to the school. If the soldier is TDY and return for his training assignment, the method includes the round-trip travel.

A comprehensive listing of TDA rates for CONUS (Continental United States) and OCONUS (outside Continental United States) locations can be secured from the installation's finance and accounting division. The estimating equation for student TDY travel is:

(based on training installation location and availability of quarters and rations and whether TDY enroute or return)
[(TDY rate) + (travel)] * (number of students)

Instructor Temporary Duty Assignments. The same stipulations (that is, the availability of quarters and meals at the travel location) and sources of information for student TDY apply to instructors. However, for travel, the equation for instructors will include round-trip costs. The estimating equation for instructor TDY is:

[(TDY rate) + (travel)] * (number of instructors)

Training Product Maintenance. Estimated time values are currently used to determine the manpower required for maintaining training products. However, there is the same concern with training product maintenance as there is with new training product development. In order to address this concern, we also surveyed the major producers of training products concerning estimates of product maintenance. Again, we used the median values obtained from this survey for the cost of maintaining training products. The recurring cost of development is shown in Table A.6. These costs include the manpower, equipment, materiel, and supply costs for each hour of product training.

[17]Discussion of these factors can be found in this Appendix under the cost factor for inflation.

Table A.6

Recurring Development Costs of Maintaining Training Products

Product	Per Hour Development Cost
Paper-based	$ 3,500
Televideo	$20,000
Computer-aided: Interactive	$ 6,000
Computer-aided: Tutorial/Modifications	$ 4,000
Interactive video disk: Interaction	$10,000
Interactive video disk: Simulation	$20,000
Demonstration	$3,500

NOTE: These are annual hourly costs for maintaining products. These products may not need revision every year, but these costs represent what the survey participants believe would be annualized factors for maintenance.

Petroleum, Oil, and Lubricants Costs. The cost of POL differs for various types of equipment and activity levels. Some items of equipment's activity levels are measured in miles and others are measured in hours. There are a number of different sources for individual POL cost factors. However, according to a DOD directive, the standard prices for POL should be those included in the DCSLOG Price Bulletin (DCSLOG PB). The Army Modernization Information Memorandum (AMIM) publishes POL rates for various types of equipment.[18] We noticed that the POL rates published by the AMIM data were extremely high as compared to those published in the Logistics Price Bulletin.

The estimating equation for POL is:

(summed over all types of equipment)
(fuel cost per operating measure) * (authorized POI activity level) * (quantity of equipment)

Replenishment Spares. This category covers the cost of components or major assemblies for various items of equipment that need to be replaced because of wear and tear. The rate at which spares need to be replenished varies according to activity levels and the number of items of equipment. Fewer items of equipment operated at high levels may require more replenishments.

Often data is not available that would allow estimation of the cost of replenishment as a function of operating levels. Currently there are rules of thumb that estimate the cost of replenishment. One such rule is a percentage that ranges from 2 to 10 percent of the manufacturing cost of the item. However, the OSMIS system is beginning to capture the costs of replenishment for major items of equipment. Another way to obtain information concerning the cost of replenishment is to use analogous systems to project the potential cost of replenishment.

The estimating equation for replenishment spares is:

[18]Some of the installations use the AMIM rates for planning purposes. These high rates give a distorted picture of the costs of operating the equipment.

(summed over all types of equipment)
(replenishment spares cost per item) * (quantity of item)

Ammunition Costs. The cost of ammunition includes bombs, missiles, and all other ordinants expended during a training course. The individual training departments can provide information on the authorized level of munitions for various training courses. There are a number of different sources for the price of munitions. However, the source used for training requirements programming is the price data provided by the Armament, Munitions, and Chemical Command (AMCCOM). The Training Ammunition Management Information System (TAMIS) tracks the cost of ammunition expended by both TDA and TOE units. The AMDF and Supply Bulletin 700-20 also include prices for ammunition. However, sometimes these are out of date.

The estimating equation for ammunition is:

(summed over all types of ammunition)
(ammunition cost per student) * (number of students) + (ammunition cost per instructor/demonstration) * (number of instructors/demonstration)

Equipment Maintenance. According to Army doctrine, repairs that cannot be done by the unit's maintenance company are forwarded to a headquarters company and from there to a forward Direct Support (DS) or General Support (GS) maintenance unit. Maintenance Allocation Charts indicate whether maintenance should be DS or GS. To estimate unit maintenance costs, the best source of information for various items of equipment is the maintenance companies within the unit, including the motor pool.

Most intermediate maintenance cost data refer to DS units. Intermediate maintenance is provided by the installation's Directorate of Logistics' maintenance division. Often these divisions use civilian contract labor. Many items of equipment may have civilian maintenance contracts that facilitate the identification of recurring maintenance expenses by items of equipment. Also, OSMIS does have some intermediate maintenance costs associated with items of equipment.

The Army's depot system is operated by the Army Materiel Command (AMC). AMC bears the burden of depot level maintenance costs, which include major overhaul, repair, and modification services. Currently, it is almost impossible to relate depot costs to the schools. It is also very difficult to associate DS and GS maintenance to a particular work unit or department.

The estimating equation for equipment maintenance is:

(summed over all items of equipment)
(annual maintenance cost per year/item of equipment) * (quantity)

Training Product Distribution. In the case of paper-based or computer-based training that is distributed to the soldiers' units, there may be expenses associated with mailing these materials. A more detailed listing of transport rates is included in the DOD Military Traffic Management Command's Quarterly Progress Report. In addition, the installation's training

support center in the Directorate of Plans, Training, and Mobilization (DPTM) can provide information on specific costs of distribution of training materials.

The estimating equation for product distribution is:

(summed over all types of product distribution)
(product packages distributed) * (cost of distribution—usually by weight) * (number of students)

Product Reproduction. The costs of reproducing the training products depend on the type of product. Training manuals are generally less expensive to reproduce than computer programs that also have operating manuals associated with them. One excellent source of information concerning the cost of product reproduction is the non-resident training division within the Directorate of Plans, Training, and Mobilization.

The estimating equation for product reproduction is:

(summed over all products)
(quantity of product reproduced) * (cost of reproduction/type of product)

Facility Maintenance. We approach the recurring costs of facility maintenance by examining the change in workload to determine the potential change in cost that results from a training change. We use a variety of workload measures of service provided in the facility maintenance area. We examine such things as number of contracts, number of work orders, etc. Costing of facility maintenance can be subject to "double counting." Current Base Operations (BASOPS) cost rates include DS/GS maintenance costs. So, if equipment maintenance cost factors cover this intermediate maintenance, then the BASOPS factor should not be used. Currently, the best source of information concerning BASOPS and facility maintenance costs are the various work units that support the installation. In the future, a model called the Base Operations Predictive Model (BOPM) will provide cost factors relating to base operations and support.

The cost estimating equation for facility maintenance is:

(summed over all types of facility maintenance)
(annual cost of maintenance for facility) * (cost of maintenance)

Inflation Factors. The controller of the Department of Defense annually publishes inflation guidance. There are separate factors for various procurement items, military pay, and civilian pay. The rates cover an eight-year period.

Appendix B
COST MODELS FOR AOAC ALTERNATIVES

This section includes the results for the alternatives we considered for the AOAC course. We also include the specific cost models for each of the alternatives—including both low- and high-cost scenario results. As shown in Table B.1, this option reduces the instructor contact hours to 5,196.4. The 152 academic hours are distributed to the 69 armor battalions. Because the training distribution for this alternative is the same as in the distributed course, we elected to analyze only one media alternative. However, we do use both the low- and high-cost implementation assumptions to assess the potential costs of this alternative. Table B.2 summarizes how this option is distributed to the units.

Table B.1

Resident Training Department Instructor Contact Hours for the Change in Mission Option

Method of Instruction	DAC ICHs	Maintenance ICHs	Weapons ICHs	C&S ICHs	Total
Conference	6	16	12	1,036.6	1,070.6
CBT	0	156	0	250.0	406.0
Demo	0	8	0	26.4	34.4
Practical exercises	0	0	0	3,160.0	3,160.0
TV/Seminar	0	0	0	1.4	1.4
Exams	0	0	0	524.0	524.0
Total	6	180	12	4,998.4	5,196.4

Table B.2

Change in Mission Alternative

Department	Resident Academic Hours Reduced	Academic Hours Distributed to Units by Media Type		
		Paper	Videotape	Computer
Deputy Assistant Commandant	-1	+1		
Weapons	-54 (30 hours eliminated)	+2	+1	+21
Maintenance	-16			+16
Command & Staff	-136 (25 hours eliminated)	+63	+15	+33
Total	-207	+66	+16	+70

Table B.3

Resident Training Department Instructor Contact Hours for the Small Group to Large Group Transformation Option

Method of Instruction	DAC ICHs	Maintenance ICHs	Weapons ICHs	C&S ICHs	Total
Conference	6	16	12	239.6	273.6
CBT	0	156	0	170.0	326.0
Demo	0	8	0	10.4	18.4
Practical exercises	0	0	0	1,322.4	1,322.4
TV/Seminar	0	0	0	1.4	1.4
Exams	0	0	0	108.0	108.0
Total	6	180	12	1,851.8	2,049.8

Table B.4

Low-Cost Trimmed Cost Model

NONRECURRING COSTS	
Separation costs of civilian personnel	
• GS-5	$8,000
• GS-7	$57,000
• GS-9	$12,000
Officer transfers	$0
Publications new proofs	$1,000
Development costs	$0
Total costs	$78,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($26,000)
• GS-7	($192,000)
• GS-9	($39,000)
Student PCS	($3,421,000)
Student TDY	$2,637,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Temporary housing maintenance	$495,000
Sustainment reduction	($16,000)
Total savings	($672,000)

Table B.5

Low-Cost Distributed Paper Cost Model

NONRECURRING COSTS	
Acquisition of temporary developers	$404,000
Initial training of new developers	$27,000
Separation costs of civilian personnel	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$47,000
Officer transfers	
• O-3	$27,000
• O-4	$10,000
Publications new proofs	$43,000
Family housing deactivated	$785,000
Temporary housing activated	$165,000
Total costs	$1,580,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($156,000)
Student PCS	($3,421,000)
Student TDY	$2,241,000
Reproduction	$56,000
Distribution	$21,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Family housing maintenance reduction	($785,000)
Temporary housing maintenance increase	$495,000
Classroom maintenance	$124,000
Total savings	($1,779,000)

Table B.6

Low-Cost Multimedia Distributed Cost Model

NONRECURRING COSTS	
Acquisition of temporary developers	$455,000
Initial training of new developers	$30,000
Separation costs of civilian personnel	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	[illegible]00
Officer transfers	
• O-3	$27,000
• O-4	$10,000
DOTD computer equipment procurement	$22,000
Publications new proofs	$28,000
Family housing deactivated	$785,000
Temporary housing activated	$165,000
Unit classrooms activated	$41,000
Total costs	$1,670,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($117,000)
Student PCS	($3,421,000)
Student TDY	$2,241,000
DOTD computer maintenance	$6,000
Reproduction	$29,000
Distribution	$21,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Family housing maintenance reduction	($785,000)
Temporary housing maintenance increase	$495,000
Classrooms maintenance increase	$124,000
Total savings	($1,761,000)

Table B.7

Low-Cost SGI Transformation Cost Model

NONRECURRING COSTS	
Acquisition of temporary developers	$506,000
Initial training of new developers	$34,000
Separation costs of civilian personnel	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$47,000
Officer transfers	
• O-3	$128,000
• O-4	$30,000
DOTD computer equipment procurement	$22,000
Publications new proofs	$28,000
Family housing deactivated	$785,000
Temporary housing activated	$165,000
Unit classrooms activated	$41,000
Total costs	$1,858,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($156,000)
Student PCS	($3,421,000)
Student TDY	$2,241,000
DOTD computer maintenance	$8,000
Reproduction	$29,000
Distribution	$21,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Family housing maintenance reduction	($785,000)
Temporary housing maintenance increase	$495,000
Classrooms maintenance increase	$124,000
Total savings	($1,798,000)

Table B.8

Low-Cost Change in Mission Cost Model

NONRECURRING COSTS	
Acquisition of temporary developers	$455,000
Initial training of new developers	$30,000
Separation costs of civilian personnel	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$47,000
Officer transfers	
• O-3	$27,000
• O-4	$10,000
DOTD computer equipment procurement	$22,000
Publications new proofs	$28,000
Family housing deactivated	$785,000
Temporary housing activated	$165,000
Unit classrooms activated	$41,000
Total costs	$1,682,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($156,000)
Student PCS	($3,421,000)
Student TDY	$2,241,000
DOTD computer maintenance	$6,000
Reproduction	$29,000
Distribution	$21,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Family housing maintenance reduction	($785,000)
Temporary housing maintenance increase	$495,000
Classrooms maintenance increase	$124,000
Total savings	($1,800,000)

Table B.9

High-Cost Trimmed Cost Model

NONRECURRING COSTS	
Separation costs of civilian personnel	
• GS-5	$8,000
• GS-7	$57,000
• GS-9	$12,000
Officer transfers	$0
Publications new proofs	$1,000
Development costs	$7,000
Total costs	$85,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($26,000)
• GS-7	($192,000)
• GS-9	($39,000)
Student PCS	($3,421,000)
Student TDY	$4,142,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Sustainment reduction	($80,000)
Family housing maintenance reduction	($785,000)
Total savings	($511,000)

Table B.10

High-Cost Distributed Paper Cost Model

NONRECURRING COSTS	
Civilian personnel costs	
Separations	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$12,000
Military personnel costs	
Initial training	$3,000
Transfers	
• O-3	$64,000
• O-4	$20,000
New training products	$1,064,000
Equipment procurement	$0
Facility deactivation	$950,000
Total costs	$2,185,000
RECURRING COSTS/(SAVINGS)	
Civilian pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($39,000)
Military personnel costs	
• Student PCS	($3 421,000)
• Student TDY	,040,000)
• Replacement training	$1,000
Training product maintenance	$0
Reproduction	$56,000
Distribution	$21,000
Ammunition	($95,000)
Weapons	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Learning center maintenance	$124,000
Family housing maintenance reduction	($785,000)
Classroom maintenance increase	$124,000
Total savings	($933,000)

Table B.11

High-Cost Distributed Multimedia Cost Model

NONRECURRING	
Civilian personnel costs	
Separations	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$12,000
Military personnel costs	
Initial training	$3,000
Transfers	
• O-3	$64,000
• O-4	$20,000
New training products	$1,942,000
Equipment procurement	
• Computers	$224,000
• Video recorders	$131,000
Initial spares	$224,000
Facility deactivation	$785,000
Construction of classrooms	$3,728,000
Total costs	$7,205,000
RECURRING COSTS/(SAVINGS)	
Civilian pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($39,000)
Military personnel costs	
• Student PCS	($3,421,000)
• Student TDY	$3,340,000
• Replacement training	$1,000
Training product maintenance	$46,000
Reproduction	$29,000
Distribution	$21,000
Computer equipment maintenance	$112,000
Video recorder maintenance	$33,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Learning center maintenance	$124,000
Family housing maintenance reduction	($785,000)
Total savings	($893,000)

Table B.12

High-Cost SGI Transformation Cost Model

NONRECURRING	
Civilian personnel costs	
Separations	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$12,000
Military personnel costs	
Initial training	$3,000
Transfers	
• O-3	$128,000
• O-4	$40,000
New training products	$2,107,000
Equipment procurement	
• Computers	$224,000
• Video recorders	$131,000
Initial spares	$224,000
Facility deactivation	$785,000
Construction of classrooms	$3,728,000
Total costs	$7,454,000
RECURRING COSTS/(SAVINGS)	
Civilian pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($39,000)
Military personnel costs	
• Student PCS	($3,421,000)
• Student TDY	$3,340,000
• Replacement training	$1,000
Training product maintenance	$26,000
Reproduction	$29,000
Distribution	$21,000
Computer equipment maintenance	$112,000
Video recorder maintenance	$33,000
Ammunition	($95,000)
Weapons	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Learning center maintenance	$124,000
Family housing maintenance reduction	($785,000)
Total savings	($913,000)

Table B.13

High-Cost Mission Change Cost Model

NONRECURRING	
Civilian personnel costs	
Separations	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$12,000
Military personnel costs	
Initial training	$3,000
Transfers	
• O-3	$64,000
• O-4	$20,000
New training products	$1,942,000
Equipment procurement	
• Computers	$224,000
• Video recorders	$131,000
Initial spares	$224,000
Facility deactivation	$785,000
Construction of classrooms	$3,728,000
Total costs	$7,205,000
RECURRING COSTS/(SAVINGS)	
Civilian pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($39,000)
Military personnel costs	
• Student PCS	($3,421,000)
• Student TDY	$3,238,000
• Replacement training	$1,000
Training product maintenance	$74,000
Reproduction	$29,000
Distribution	$21,000
Computer equipment maintenance	$112,000
Video recorder maintenance	$33,000
Ammunition	($95,000)
Weapons	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Learning center maintenance	$124,000
Family housing maintenance reduction	($785,000)
Total savings	($966,000)

Table B.14

Low-Cost Teletraining Cost Model

NONRECURRING COSTS	
Acquisition of temporary developers	$455,000
Initial training of new developers	$30,000
Separation costs of civilian personnel	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$35,000
Officer transfers	
• O-3	$27,000
• O-4	$10,000
DOTD computer equipment procurement	$22,000
Teletraining equipment	$1,330,000
Publications new proofs	$28,000
Family housing deactivated	$785,000
Temporary housing activated	$165,000
Unit classrooms activated	$41,000
Total costs	$3,000,000
RECURRING COSTS/(SAVINGS)	
Civilian personnel pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($117,000)
Student PCS	($3,421,000)
Student TDY	$2,241,000
DOTD computer maintenance	$6,000
Teletraining equipment maintenance	$1,512,700
Teletraining scheduling	$648,300
Reproduction	$29,000
Distribution	$21,000
Ammunition	($95,000)
Major weapon systems (POL and spares)	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Family housing maintenance reduction	($785,000)
Temporary housing maintenance increase	$495,000
Classrooms maintenance increase	$124,000
Total savings	$400,000

Table B.15

High-Cost Teletraining Cost Model

NONRECURRING	
Civilian personnel costs	
Separations	
• GS-5	$15,000
• GS-7	$57,000
• GS-9	$12,000
Military personnel costs	
Initial training	$3,000
Transfers	
• O-3	$64,000
• O-4	$20,000
New training products	$1,942,000
• Computers	$224,000
• Video recorders	$131,000
Initial spares	$224,000
Teletraining equipment	$1 330,000
Facility deactivation	$785,000
Construction of classrooms	$3,728,000
Total costs	$8,535,000
RECURRING COSTS/(SAVINGS)	
Civilian pay and allowances	
• GS-5	($52,000)
• GS-7	($192,000)
• GS-9	($39,000)
Military personnel costs	
• Student PCS	($3,421,000)
• Student TDY	$3,340,000
• Replacement training	$1,000
Training product maintenance	$46,000
Reproduction	$29,000
Distribution	$21,000
Computer equipment maintenance	$112,000
Teletraining maintenance	$1,885,100
Teletraining scheduling	$807,900
Video recorder maintenance	$33,000
Ammunition	($95,000)
Weapons	
• M1	($3,000)
• M1A1	($8,000)
• M60A3	($4,000)
Learning center maintenance	$124,000
Family housing maintenance reduction	($785,000)
Total savings	$1,800,000

Appendix C
M1/M1A1 ARMOR CREWMAN OSUT COURSE

There are a number of differences in the delivery changes resulting from the high-cost assumptions. First, the 1st Armor Training Brigade TDA authorization for tanks during FY 93 is 109. Second, the implementation schedule for the TADSS is different. The reason the schedule is different is that we do not "cannibalize" existing tanks for the turret trainers or the driver training vehicles, but must procure these TADSS. Table C.1 shows the timing of TADSS integration for our high-cost assumptions.

Table C.1

TADSS Implementation: High-Cost Assumptions

Fiscal Years	Driver Trainer	Turret Trainer	Driver Training Vehicle	Tanks
FY 93				
• 1st quarter				
• 2nd quarter	9			-7
• 3rd quarter	9			-7
• 4th quarter	9			-7
FY 94				
• 1st quarter	9			-39
• 2nd quarter	9			-39
• 3rd quarter	9			-39
• 4th quarter	9			-39
FY 95				
• 1st quarter	9	27	14	-39
• 2nd quarter	9	27	14	-39
• 3rd quarter	9	27	14	-39
• 4th quarter	9	27	14	-39

With our high-cost set of assumptions, we do not include any time savings from the set-up or tear-down of the tanks. Under our low-cost assumptions we were able to reduce the 1st Armor Training Brigade's inventory by 29 tanks. For our high-cost assumptions, our net is higher because our baseline number of tanks is 109.[1]

Tables C.2, C.3, and C.4 summarize the high-cost delivery activity changes occurring during FY 93, FY 94, and FY 95.

[1]The calculation for the authorized number of tanks is based on 629 tank days remaining per iteration * 22 iterations in FY 95/250 training days. However, we are not achieving any time savings so we still need to include the complete set-up and tear-down factor of 1.25. This calculation yields a requirement for 70 tanks.

Table C.2

FY 93 Changes in Delivery Activities: High-Cost Assumptions

	Decrease	Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC PORTION					
PE-1 with tanks	-13 hours				-13 hours
PE-2 with TADSS		+13 hours	+13 hours		+13 hours
Tank miles per iteration					
• 1st quarter					
• 2nd quarter (DT)	-151 miles				-151 miles
• 3rd quarter (DT)	-151 miles				-151 miles
• 4th quarter (DT)	-151 miles				-151 miles

During FY 93, we implement the driver trainer only for the vehicle-specific portion of the course. Table C.2 shows that the only mileage savings occur with the implementation of this device. Table C.3 highlights the changes in delivery during FY 94. All training changes except the turret trainers and the driver training vehicles are implemented at the beginning of FY 94.

Table C.3

FY 94 Changes in Delivery Activities: High-Cost Assumptions

	Decrease	Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC PORTION					
PE-1 with tanks	-18.6 hours				-18.6 hours
PE-2 with TADSS		+13 hours			+13 hours
Conference	-5 hours				-5 hours
CBT		+21.7 hours			+21.7 hours
Demo	-8.7 hours				-8.7 hours
PE-3	-0.5 hours				-0.5 hours
TV		+0.1 hours			+0.1 hours
VEHICLE-SPECIFIC CHANGE	-32.8 hours	+34.8 hours			+2 hours
BASIC TRAINING PORTION					
PE-1	-0.6 hours				-0.6 hours
PE-2	-13.6 hours				-13.6 hours
PE-3	-8 hours				-8 hours
Conference	-18.9 hours				-18.9 hours
CBT		+46 hours			+46 hours
Demo	-4.6 hours				-4.6 hours
TV	-0.3 hours				-0.3 hours
BASIC TRAINING CHANGE	-46 hours	+46 hours			0 hours
Tank miles per iteration	-151 miles				-151 miles
Battalion ICHs	+108 ICHs				+108 ICHs

In Table C.3, we also separate the two major portions of the course—the vehicle-specific and the basic portion. Also, there are an additional two hours of instruction added during FY 94. This two hour addition represents an increase of 108 instructor contact hours per iteration for the instructors in the vehicle-specific portion of the course.

Table C.4 shows the changes in delivery for FY 95. Full implementation of the changes occurs during this fiscal year.

Table C.4

FY 95 Changes in Delivery Activities: High-Cost Assumptions

	Decrease	Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC PORTION					
PE-1 with tanks	-74.8 hours				-74.8 hours
PE-2 with TADSS		+69.2 hours			+69.2 hours
Conference	-5 hours				-5 hours
CBT		+21.7			+21.7 hours
Demo	-8.7 hours				-8.7 hours
PE-3	-0.5 hours				-0.5 hours
TV		+0.1 hours			+0.1 hours
VEHICLE-SPECIFIC CHANGE	-32.8 hours	+34.8 hours			+2 hours
BASIC TRAINING PORTION					
PE-1	-0.6 hours				-0.6 hours
PE-2	-13.6 hours				-13.6 hours
PE-3	-8 hours				-8 hours
Conference	-18.9 hours				-18.9 hours
CBT		+46 hours			+46 hours
Demo	-4.6 hours				-4.6 hours
TV	-0.3 hours				-0.3 hours
BASIC TRAINING CHANGE	-46 hours	+46 hours			0 hours
Tank miles per iteration	-691 miles				-691 miles
Tank miles to DTV Driver trainer miles	-4,660 miles +4,660 miles				-4,660 miles +4,660 miles
Battalion ICHs	+108 ICHs				+108 ICHs

The total changes for each year for academic hours, miles, and ICHs are driven by the forecasted student input. Table C 5 summarizes the effects of student input on the ICHs and miles for our high-cost assumption implementation alternative.

Table C.5

Summary of High-Cost Assumption Delivery Changes by Fiscal Year

	FY 93	FY 94	FY 95
Annual iterations	15	9	22
Total ICHs		+972	+2,376
Tank miles converted to DTV			102,520
Total miles reduced	-1,812	-1,359	-15,202

Our high-cost assumptions use development hours as the workload factor for development. Table C.6 summarizes the changes in development activity hours for FY 93. The high-cost assumptions postulate that during FY 93 new development activities are occurring for all aspects of the course. However, savings from sustainment during FY 93 are possible only in the practice exercises where we substitute the driver trainer for the tanks.

Table C.6

FY 93 Changes in Development Activities: High-Cost Assumptions

Instructional Product Hours	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference					
CBT		+21.7			+21.7
Demonstration					
PE-1	-13				-13
PE-2					
PE-2 with TADSS		+69.2			+69.2
PE-3					
TV		+0.1			+0.1
TOTAL VEHICLE-SPECIFIC	-13	+91			+78
BASIC TRAINING					
Conference					
CBT		+46			
Demonstration					
PE-1					
PE-2					
PE-2 with TADSS					
PE-3					
TV					
BASIC TOTAL		+46			+46
Revise instructor course POI	-1	+1			0
Revise course POI	-1	+1			0
TOTAL COURSE	-15	+139			+124

By the beginning of FY 94, the one-time development activities are completed for our high-cost set of assumptions. However, the sustainment activities still need to include some of the original baseline activities because not all changes are implemented at the beginning of FY 94. The practical exercises that include substituting the turret trainer and the driver training vehicle are not implemented until the beginning of FY 95. Table C.7 highlights the changes in sustainment activities for FY 94.

Table C.7

FY 94 Changes in Development Sustainment Activities: High-Cost Assumptions

Instructional Product Hours	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference	-5				-5
CBT		+21.7			+21.7
Demonstration	-8.7				-8.7
PE-1	-18.6				-18.6
PE-2					
PE-2 with TADSS		+13			+13
PE-3	-0.5				-0.5
TV		+0.1			+0.1
TOTAL VEHICLE-SPECIFIC	-32.8	+34.8			+2
BASIC TRAINING					
Conference	-18.9				-18.9
CBT		+46			+46
Demonstration	-4.6				-4.6
PE-1	-0.6				-0.6
PE-2	-13.6				-13.6
PE-2 with TADSS					
PE-3	-8				-8
TV	-0.3				-0.3
BASIC TOTAL	-46	+46			0
Instructor course POI	-1	+1			0
Course POI	-1	+1			0
TOTAL COURSE	-80.8	+82.8			+2

Beginning with FY 95, all changes in development sustainment activities are implemented. Table C.8 summarizes these changes for our high-cost assumptions.

Table C.8

FY 95 Changes in Development Sustainment Activities: High-Cost Assumptions

Instructional Product Hours	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
VEHICLE-SPECIFIC					
Conference	-5				-5
CBT		+21.7			+21.7
Demonstration	-8.7				-8.7
PE-1	-74.8				-74.8
PE-2					
PE-2 with TADSS		+69.2			+69.2
PE-3	-0.5				-0.5
TV		+0.1			+0.1
TOTAL VEHICLE-SPECIFIC	-89	+91			+2
BASIC TRAINING					
Conference	-18.9				-18.9
CBT		+46			+46
Demonstration	-4.6				-4.6
PE-1	-0.6				-0.6
PE-2	-13.6				-13.6
PE-2 with TADSS					
PE-3	-8				-8
TV	-0.3				-0.3
BASIC TOTAL	-46	+46			0
Instructor course POI	-1	+1			0
Course POI	-1	+1			0
TOTAL COURSE	-137	+139			+2

The net result in recurring development activities as a result of our high-cost alternative is an additional two hours of development sustainment.

For our high-cost assumptions, support activity changes are different and the differences are due principally to the need to develop and procure the driver training vehicle and the turret trainers. Table C.9 summarizes the changes in support activities for FY 93.

Table C.9

FY 93 Changes in Support Activities: High-Cost Assumptions

Support Activities	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
1ST ARMOR TRAINING BRIGADE					
Level one maintenance					
• Tank maintenance	-453 hours				-453 hours
• DT maintenance		+112 hours			+112 hours
• Turret trainers					
• DTV					
Battalion/Brigade maintenance					
• Tank maintenance	-420 hours				-420 hours
• DT maintenance		+100 hours			+100 hours
• Turret trainers					
• DTV					
Initial instructor training		+1 week			+1 week
Replacement training		+1 week			+1 week
DOTD					
Publications		-15 product hours	+139 product hours		+124 product hours
DOL					
Higher level maintenance					
• Tanks	-1,812 miles				-1,812 miles

Tables C.10 and C.11 summarize the changes in support for FY 94 and FY 95.

Table C.10

FY 94 Changes in Support Activities: High-Cost Assumptions

Support Activities	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
1ST ARMOR TRAINING BRIGADE					
Level one maintenance					
• Tank maintenance	-2,525 hours				-2,525 hours
• DT maintenance		+112 hours			+112 hours
• Turret trainers					
• DTV					
Battalion/Brigade maintenance					
• Tank maintenance	-2,272 hours				-2,272 hours
• DT maintenance		+100 hours			+100 hours
• Turret trainers					
• DTV					
• CBT		+115 hours			+115 hours
Replacement training		+1 week			+1 week
DOTD					
Publications	-80.8 product hours	+82.8 product hours			+2 product hours
DOL					
Higher level maintenance					
• Tanks	-1,359 miles				-1,359 miles

Table C.11

FY 95 Changes in Support Activities: High-Cost Assumptions

Support Activities	School Decrease	School Increase	Transfer to Excess Capacity	Transfer from Excess Capacity	Net Change
1ST ARMOR TRAINING BRIGADE					
Level one maintenance					
• Tank maintenance	-2,525 hours				-2,525 hours
• DT maintenance		+112 hours			+112 hours
• Turret trainers		+882 hours			+882 hours
• DTV		+175 hours			+175 hours
• CBT		+115 hours			+115 hours
Battalion/Brigade maintenance					
• Tank maintenance	-2,272 hours				-2,272 hours
• DT maintenance		+100 hours			+100 hours
• Turret trainers		+792 hours			+792 hours
• DTV		+175 hours			+175 hours
• CBT		+115 hours			+115 hours
Replacement training		+1 week			+1 week
DOTD					
Publications	-137 product hours	+139 product hours			+2 product hours
DOL					
Higher level maintenance					
• Tanks	-117,722 miles				-117,722 miles
• DTV		+102,520 miles			+102,520 miles

Table C.12 is the catalogue of activity and workload changes for FY 93 for the high-cost option.

Table C.12

FY 93 Catalogue of TADSS Alternative Activity and Workload Changes: High-Cost Option

Activity/Workload Changes	Type of Activity	
	One-time/Transition?	Recurring?
DELIVERY		
Tank miles (-1,812 miles)		X
DEVELOPMENT		
New development hours (+139 hours)	X	
Development sustainment (-15 hours)		X
SUPPORT		
Level one maintenance		X
• Tank maintenance (-453 hours)		X
• DT maintenance (+112 hours)		X
Battalion/Brigade maintenance		
• Tank maintenance (-420 hours)		X
• DT maintenance (+100 hours)		X
Instructor training (+1 week)	X	
Replacement training (+1 week)		X
Publications (-15 hours/+139 hours)	X	X
Higher level maintenance		
• Tank miles (-1,812 miles)		X

Tables C.13 and C.14 summarize the activity changes for the high-cost alternative for FY 94 and FY 95.

Table C.13

FY 94 Catalogue of TADSS Alternative Activity and Workload Changes: High-Cost Option

Activity/Workload Changes	Type of Activity	
	One-time/Transition?	Recurring?
DELIVERY		
1st Armor Training Brigade (+972 ICHs)		X
Tank miles (-1,359 miles)		X
DEVELOPMENT		
New development hours (+82.8 hours)	X	
Development sustainment (-80.8 hours)		X
SUPPORT		
Level one maintenance		
• Tank maintenance (-2,525 hours)		X
• DT maintenance (+112 hours)		X
Battalion/Brigade maintenance		
• Tank maintenance (-2,272 hours)		X
• DT maintenance (+100 hours)		X
• CBT (+115 hours)		X
Replacement training (+1 week)		X
Publications (-80.8 old/+82.8 new)	X	X
Higher level maintenance		
• Tank miles (-1,359 miles)		X

Table C.14

FY 95 Catalogue of TADSS Alternative Activity and Workload Changes: High-Cost Option

Activity/Workload Changes	Type of Activity	
	One-time/Transition?	Recurring?
DELIVERY		
1st Armor Training Brigade (+2,376 ICHs)		X
Tank miles (-117,722 miles)		X
DTV miles (+102,520 miles)		X
DEVELOPMENT		
Development sustainment (+2 hours)		X
SUPPORT		
Level one maintenance		
• Tank maintenance (-2,525 hours)		X
• DT maintenance (+112 hours)		X
• Turret trainer maintenance (+882 hours)		X
• DTV maintenance (+194 hours)		X
Battalion/Brigade maintenance		
• Tank maintenance (-2,272 hours)		X
• DT maintenance (+100 hours)		X
• Turret trainer maintenance (+792 hours)		X
• DTV maintenance (+175 hours)		X
• CBT (+115 hours)		X
Replacement training (+1 week)		X
Publications (+2 new)		X
Higher level maintenance		
• Tank miles (-117,722 miles)		X
• DTV (+102,520 miles)		X

Tables C.15, C.16, and C.17 are the manpower balance sheets for the period of FY 93 through FY 95 for the high-cost alternative.

Table C.15

FY 93 TADSS Alternative Manpower Balance Sheet: High-Cost Assumptions

	School Decrease	School Increase	Other	Transfer to Other Organizations	Net Change	O.T./Rec.
Support						
• Military (grade)	-3 E-3	+1 E-3		+2 E-3	0	O.T.
	-2 E-4	+1 E-4		+1 E-4	0	O.T.

Table C.16

FY 94 TADSS Alternative Manpower Balance Sheet: High-Cost Assumptions

	School Decrease	School Increase	Other	Transfer to Other Organizations	Net Change	O.T./Rec.
Delivery						
• Military (grade)		+ 1 E-6		-1 E-6	0	O.T.
Support						
• Military (grade)	(-14)/-17 E-3	+11 E-3		(+13)/+15 E-3	0	O.T.
	(-13)/-15 E-4	+2 E-4		(+11)/+12 E-4	0	O.T.

Table C.17

FY 95 TADSS Alternative Manpower Balance Sheet: High-Cost Assumptions

	School Decrease	School Increase	Other	Transfer to Other Organizations	Net Change	O.T./Rec.
Delivery						
• Military (grade)		+2 E-6		-2 E-6	0	O.T.
Support						
• Military (grade)	(-3)/-17 E-3	+8 E-3		(+3)/+25 E-3	0	O.T.
• Civilian (grade)	(-1)/-16 E-3	+8 E-4		(+1)/+22 E-4	0	O.T.

Tables C.18, C.19, and C.20 are the balance sheets for the equipment/supplies/materiel changes for the high-cost option.

Table C.18

FY 93 TADSS Alternative Equipment Balance Sheet: High-Cost Assumptions

	School Decrease	School Increase	Other	Excess Capacity	Net Change	O.T./Rec.
Delivery						
• Tanks	-7			+7		O.T.
• DT		+9			+9 DT	O.T./Rec.
Support						
• DT spares		+9			+9	O.T./Rec.
• M1A1 spares	-7			+7		O.T./Rec.

Table C.19

FY 94 TADSS Alternative Equipment Balance Sheet: High-Cost Assumptions

	School Decrease	School Increase	Other	Excess Capacity	Net Change	O.T./Rec.
Delivery						
• Tanks	-39			+39		O.T.
• DT		+9			+9 DT	O.T./Rec.
• CBT		+27			+27 CBT	O.T./Rec.
Support						
• DT spares		+9			+9	O.T./Rec.
• CBT spares		+27			+27	O.T./Rec.
• M1A1 spares	-39			+39		

Table C.20

FY 95 TADSS Alternative Equipment Balance Sheet: High-Cost Assumptions

	School Decrease	School Increase	Other	Excess Capacity	Net Change	O.T./Rec.
Delivery						
• Tanks	-39			+39		O.T.
• DT		+9			+9 DT	O.T./Rec.
• TT		+27			+27 TT	O.T./Rec.
• DTV		+14			+14 DTV	O.T./Rec.
• CBT		+27			+27 CBT	O.T./Rec.
Support						
• DT spares		+9			+9	Rec.
• CBT spares		+27			+27	Rec.
• M1A1 spares	-39			+39		
• TT spares		+27			+27	Rec.
• DTV spares		+14			+14	Rec.

Once the balance sheets are completed, we can summarize the cost-causing changes. Tables C.21, C.22, and C.23 show the cost-causing changes for the high-cost alternative for the period of FY 93 through FY 95.

Table C.21

FY 93 Catalogue of Cost-Causing Changes for High-Cost TADSS Alternative

	Basis for Estimate	Nonrecurring	Recurring
DELIVERY			
Tank training	-1,812 miles		X
DEVELOPMENT			
New product development	+139 hours	X	
Development sustainment	-15 hours		
SUPPORT			
Level one maintenance			
• Tank maintenance	-453 hours		X
• DT maintenance	+112 hours		X
Battalion/Brigade maintenance			
• Tank maintenance	-420 hours		X
• DT maintenance	+100 hours		X
Initial instructor training	+1 week	X	
Replacement training	+1 week	X	
Publications	-15 old/+139 new	X	X
Higher level maintenance			
• Tank miles	-1,812 miles		X
MANPOWER			
Military transfers			
• Tank commanders (E-6)	0		
• Level one maintenance (E-3)	+2	X	
• Level two maintenance (E-4)	+1	X	
EQUIPMENT			
M1/M1A1 tanks	-7		X
DT	+9	X	X
DT spares	+9	X	X

Table C.22

FY 94 Catalogue of Cost-Causing Changes for High-Cost TADSS Alternative

	Basis for Estimate	Nonrecurring	Recurring
DELIVERY			
1st Armor Training Brigade	+972 ICHs		
Tank training	-1,359 miles		X
DEVELOPMENT			
New product development	+82.8 hours	X	
Development sustainment	-80.0 hours		
SUPPORT			
Level one maintenance			
• Tank maintenance	-2,525 hours		X
• DT maintenance	+112 hours		X
Battalion/Brigade maintenance			
• Tank maintenance	-2,272 hours		X
• DT maintenance	+100 hours		X
• CBT	+115 hours		X
Replacement training	+1 week	X	
Publications	-80.8 old/+82.8 new	X	X
Higher level maintenance			
• Tank miles	-1,359 miles		X
MANPOWER			
Military transfers			
• Tank commanders (E-6)	+1	X	
• Level one maintenance (E-3)	(+14)/16	X	
• Level two maintenance (E-4)	(+13)/14	X	
EQUIPMENT			
M1/M1A1 tanks			X
DT	+9	X	X
DT spares	+9	X	X
CBT	+27	X	X
CBT spares	+27	X	X

Table C.23

FY 95 Catalogue of Cost Causing Changes for High-Cost TADSS Alternative

	Basis for Estimate	Nonrecurring	Recurring
DELIVERY			
1st Armor Training Brigade	+2,376 ICHs		
Tank training	-117,722 miles		X
DT training	+102,520 miles		
DEVELOPMENT			
Development sustainment	+2 hours		
SUPPORT			
Level one maintenance			
• Tank maintenance	-2,525 hours		X
• DT maintenance	+112 hours		X
• TT maintenance	+882 hours		X
• DTV maintenance	+194 hours		X
Battalion/Brigade maintenance			
• Tank maintenance	-2,272 hours		X
• DT maintenance	+100 hours		X
• TT maintenance	+792 hours		X
• DTV maintenance	+175 hours		X
• CBT	+115 hours		X
Replacement training	+1 week	X	
Publications	+2 new	X	X
Higher level maintenance			
• Tank miles	-117,722 miles		X
• DTV miles	+102,520 miles		X
MANPOWER			
Military transfers			
• Tank commanders (E-6)	(+1)/2	X	
• Level one maintenance (E-3)	(+3)/25	X	
• Level two maintenance (E-4)	(+1)/22	X	
EQUIPMENT			
M1/M1A1 tanks			X
DT	+9	X	X
TT	+27	X	X
DTV	+14	X	X
CBT	+27	X	X
CBT spares	+27	X	X
DT spare	+9		X
TT spares	+27		X
DTV spares	+14		X

Once we have catalogued the cost-causing changes, we can apply our cost models to the individual years to calculate the cost changes on a year-by-year basis. Tables C.24, C.25, and C.26 are the cost models for the low-cost alternative. The dollar rates are constant FY 93 dollars.

Table C.24

FY 93 Low-Cost Alternative Cost Results

NONRECURRING	
Civilian personnel costs	
• Civilian acquisition	$79,300
• Civilian salaries	$396,700
• Civilian training	$15,900
• Military training	$16,000
Military transfers	
• E-6	$6,100
• E-3	$12,200
• E-4	$9,200
New product publications	$53,300
Tank upgrades	$0
Equipment procurement	
• DT (box)	$36,000
• DTV (half tank)	$2,800,000
• Turret trainer	$2,100,000
• CBT equipment	$81,000
Initial spares for CBT	$40,500
One-time cost for turret trainers	$280,000
Total	$5,926,200
RECURRING	
Replacement military training	$8,500
Tank training	
• POL	($233,200)
• Consumables	($1,612,500)
• Repairables	($5,066,600)
DTV training	
• POL	$80,900
• Consumables	$377,500
• Repairables	$1,152,400
New equipment maintenance	
• DT	$1,800
• DTV	$140,000
• Turret trainer	$210,000
• CBT	$13,500
Total	($4,927,700)

Table C.25

FY 94 Low-Cost Alternative Cost Results

NONRECURRING	
Civilian personnel costs	
• Civilian acquisition	$6,100
• Civilian salaries	
• Civilian training	$1,200
Military transfers	
• E-6	$9,200
• E-3	$3,100
• E-4	$3,100
Equipment procurement	
• Turret trainer	$1,950,000
One-time cost for turret trainers	$260,000
Total	$2,232,600
RECURRING	
Replacement military training	$7,300
Tank training	
• POL	($244,200)
• Consumables	($1,688,500)
• Repairables	($5,305,200)
DTV training	
• POL	$80,900
• Consumables	$377,500
• Repairables	$1,153,400
New equipment maintenance	
• Box	$1,800
• DTV	$140,000
• Turret trainer	$210,000
• CBT	$13,500
Publications	$18,500
Total	($5,234,900)

Table C.26

FY 95 Low-Cost Alternative Cost Results

NONRECURRING	
Civilian personnel costs	$0
• Civilian acquisition	$0
• Civilian salaries	$0
• Civilian training	$0
Military transfers	
• E-6	$24,400
Equipment procurement	
• Turret trainer	$0
Total	$24,400
RECURRING	
Replacement military training	$9,800
Tank training	
• POL	($596,900)
• Consumables	($4,127,300)
• Repairables	($12,968,300)
DTV training	
• POL	$197,900
• Consumables	$922,700
• Repairables	$2,819,300
New equipment maintenance	
• Box	$1,800
• DTV	$140,000
• Turret trainer	$210,000
• CBT	$13,500
Publications	$18,500
Total	($13,359,000)

Tables C.27, C 28, and C.29 are the cost results for our high-cost alternative for the period of FY 93 through FY 95.

Table C.27

FY 93 High-Cost Results

NONRECURRING	
Development	$3,352,800
Military training	$32,900
Military transfers	
• E-6	$0
• E-3	$6,100
• E-4	$3,100
New product publications	$213,000
Equipment procurement	
• Box	$36,000
Initial DTS stock	$9,000
Total	$3,652,900
RECURRING	
Replacement military training	$8,500
Tank training	
• POL	($9,200)
• Consumables	($63,500)
• Repairables	$0
New equipment maintenance	
• Box	$9,000
Total	($55,200)

Table C.28

FY 94 High-Cost Results

NONRECURRING	
Military transfers	
• E-6	$3,100
• E-3	$42,700
• E-4	$39,700
Equipment procurement	
• DT (box)	$0
• DTV (half tank)	$7,000,000
• Turret trainer	$6,750,000
One-time cost for turret trainers	$540,000
Initial stock DTV	$1,260,000
Initial stock TT	$2,430,000
CBT	$108,200
New publications	$82,800
Total	$18,256,300
RECURRING	
Development sustainment	$56,600
Replacement military training	$8,500
Tank training	
• POL	($6,900)
• Consumables	($47,600)
• Repairables	$0
• Box spares	$18,000
• CBT spares	$27,000
Total	$55,600

Table C.29

FY 95 High-Cost Results

NONRECURRING	
Military transfers	
• E-6	$3,100
• E-3	$9,200
• E-4	$3,100
Equipment procurement	
• DT (box)	$0
• DTV (half tank)	
• Turret trainer	
One-time cost for turret trainers	
Initial stock DTV	
Initial stock TT	
Total	$15,400
RECURRING	
Replacement military training	$8,500
Tank training	
• POL	($596,900)
• Consumables	($4,127,300)
• Repairables	($8,240,500)
DTV training	
• POL	$197,900
• Consumables	$1,537,800
• Repairables	$3,075,600
New equipment maintenance	
• Box	$18,000
• Turret trainer	$540,000
• CBT	$27,000
Total	($7,559,900)

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